Association of Computer Users
4800 Riverbend Road • Post Office Box 9003 • Boulder Colorado 80301 • 303/443-3600

CONTENTS & FILING INSTRUCTIONS

ACU VOLUME 3.3 - BENCHMARK REPORT SERIES #1 & #2 CONT.

Index Tab	Current Contents	Current Action
Contents	This page	Replace previous page with this new contents page
1	IBM 5120	None
2	SD Systems SD-200	None
3	WANG 2200SVP	None
4	ALTOS ACS8000-15 & ACS8000-6	None
5	NEC Astra 205	None
6	DYNABYTE 5300	None
7	Six Issue Summary	None
8	BILLINGS BC-12 DF2M	None
9	COMMODORE CBM 8032	Insert the enclosed letter behind this index tab
10	SMOKE SIGNAL CHIEFTAIN	None
11	VECTOR GRAPHIC 3005	None
12	XEROX 820	Insert the enclosed report behind this index tab
13	IBM Personal Computer	Insert the enclosed report behind this index tab
14	Twelve Issue Summary	Insert the enclosed report behind this index tab

Date: January, 1982 Copyright 1982
Association of Computer Users Update No. Q6

ASSOCIATION OF COMPUTER USERS

Volume 3.3

Dear ACU Member,

Thank you for subscribing to the continuation of ACU's *BENCHMARK REPORT*, Series #1 & #2.

The main value of these reports is simply to help you narrow down your choices when considering small computer systems costing under $25,000. Instead of each member "reinventing the wheel" and analyzing each system from scratch, our intent is to provide you with valuable comparative information at a price which is far below the cost of doing the research yourself.

Of course, your own needs should dictate which system you ultimately choose, and we are specifically **not** endorsing or recommending any particular vendor or machine. The choice is yours; we only hope to help you by providing the only source of unbiased, user-oriented, benchmark information available today.

Sincerely,

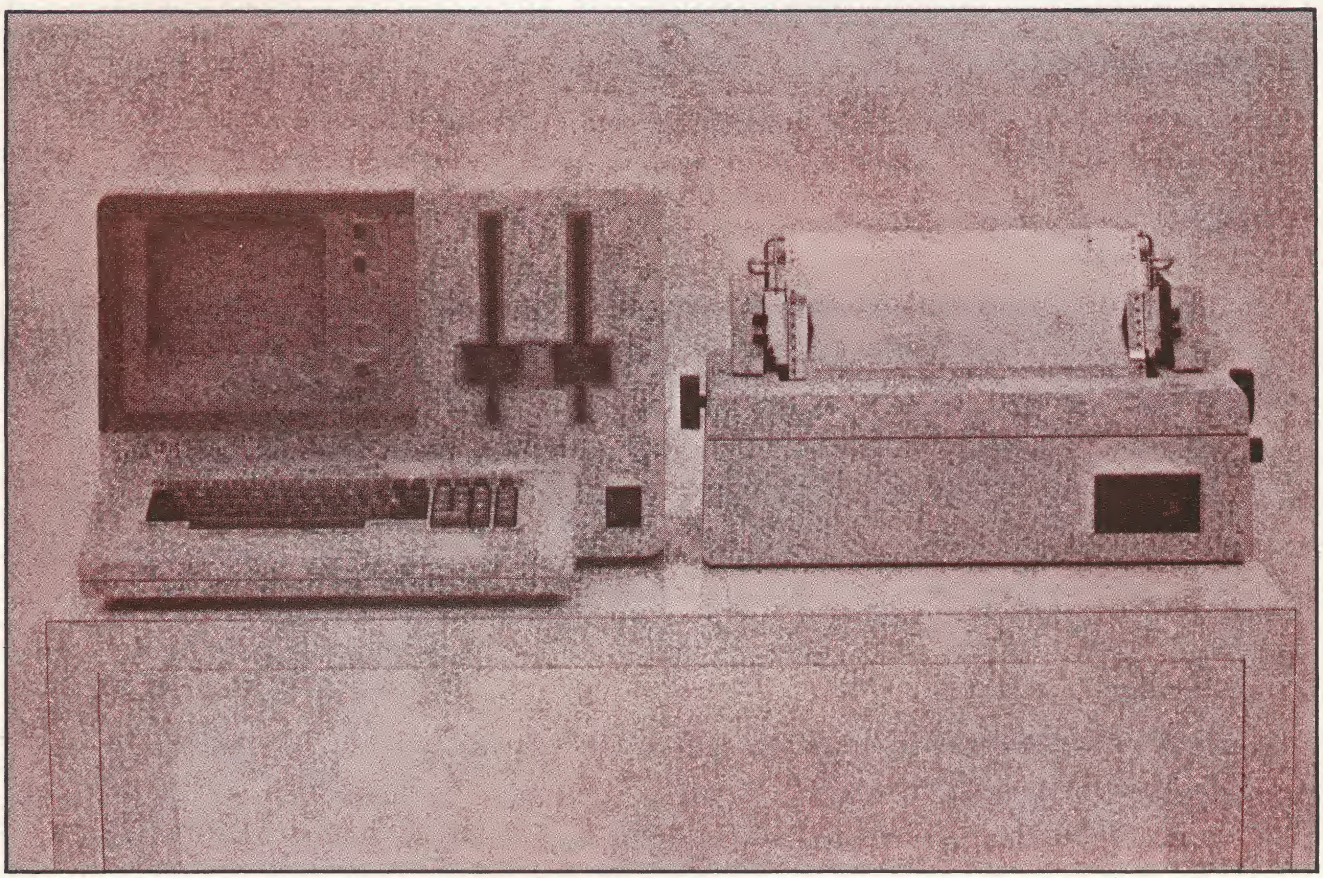
Hillel Segal

Hillel Segal, President

BENCHMARK REPORT/

Association of Computer Users

VOLUME 3.3, NUMBER 1, JUNE 1981



In This Issue:

The IBM 5120

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

IBM 5120: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: IBM 5120	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

This report on the IBM 5120 is the first in a new series of Benchmark Reports--a Continuation of Series 1 and 2. Series 1 computers cost under $15,000 and Series 2 systems were priced between $15,000 and $25,000. In this series then, we will be evaluating computer systems costing under $25,000 and designed principally for single users.

The heart of these reports is the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. The results of these benchmark runs provide comparative information which is simply unavailable from any other independent source. The benchmark programs themselves have been designed to run without change on most small computer systems. Thus, differences in performance among systems can be attributed to differences in computing capabilities.

In addition to the benchmark results, these reports contain information on the alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on the ease of use of the system. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report. The experiences of users add a dimension of reality to the technical details of the system.

Information provided by manufacturers can often be difficult to interpret and sometimes misleading. While some of the potential buyers of microcomputers have some background with computers, the majority we've surveyed are buying their first computer, and often the personnel using it will not have had much direct experience with computers. We feel these reports are invaluable to experienced and inexperienced users alike by providing an unbiased assessment of some of the microcomputer systems on the market today. Our results, which are comparable across computer systems and our observations of the system in a "real world" setting can help potential users intelligently select a system that is best for them.

EXECUTIVE SUMMARY

The IBM 5120 is a single desk-top unit with two double-sided double-density disk drives for 2.4 megabytes on-line storage, a 9-inch video display, a typewriter keyboard with function and programmable function keys, 32K central memory, IBM's BASIC, and a 5103 Model 12, 120 character-per-second printer. Since IBM chose not to assist us with our evaluation of the 5120, we located a user with this configuration and ran the benchmark programs at his site.

- The 5120's benchmark timings were interesting because even though it placed among the fastest systems we've tested for the CPU-intensive programs with exponentiation and square root, its overall times put it among the slowest of the 24 systems we've tested so far.

- IBM offers many application packages and has a far reaching network of software and hardware support services. However, the user is expected to implement and modify the packages himself.

- System documentation was complete but the information was spread over two or three manuals and we tended to look through all of them to make sure we hadn't missed anything--a time consuming process.

- IBM's BASIC is quite powerful and includes matrix operations, mathematical and user defined functions, double precision numbers and presetting number comparison tolerances.

- There is no distinction (to the user) between the operating system and a program/development mode. Thus, all commands are BASIC commands.

- Users may add two more disk drives for a total of 4.8 megabytes on-line storage but the limited expansion capability along with the 9-inch screen are two major drawbacks of the system.

- Our user survey, although composed of a small sample, revealed that users were generally pleased with their system.

The IBM 5120 is an attractive and compact business and/or engineering microcomputer that is carefully packaged and is backed by a large network of service representatives from the IBM Corporation. Without expansion capability, however, its flexibility and compatibility for some applications will be limited. It is most compatible with very small businesses or departments without large data base needs.

BENCHMARK REPORT

SYSTEM: IBM 5120

PRICE AS TESTED: $13,705

SPEED TESTS

Benchmark Number		TOTAL TIME Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500		21.4
A-2	N = 1000		41.8
A-3	N = 2000	1	22.9
A-4	N = 3000	2	3.9
A-5	N = 500		24.9
A-6	N = 1000		48.9
A-7	N = 2000	1	37.3
A-8	N = 3000	2	25.5
	I/O INTENSIVE		
B-1	N = 500	2	23.6
B-2	N = 1000	2	43.3
B-3	N = 2000	3	20.9
B-4	N = 3000	3	58.0

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	35	29.7
C-1A		12	43.0
C-2	NEW PRODUCT PLANNING		25.0
C-2A		1	18.4
C-3	ACCOUNTS RECEIVABLE	4	16.2
C-3A		5	55.9

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	134
E-2	SUBJECTIVE JUDGMENT	Very Efficient

THE BENCHMARK PROCESS

The IBM 5120 as configured for our tests consisted of a single unit containing a 9-inch CRT, two 1.4 megabyte floppy disk drives and a typewriter keyboard with a separate numeric pad. The printer was a 5103 Model 12, 120 character-per-second bidirectional printer. The benchmark programs were run in IBM's excellent BASIC. Since IBM declined to participate in our benchmark process we located a user with this configuration and conducted the tests in his offices.

Preparing for our benchmarking was quite simple and through a menu-driven process we copied the system disk onto a blank diskette by LINK and INTL commands. The new diskette then had to be formatted by allocating actual kilobytes of space required for each file to be created. This procedure is absolutely mandatory for each diskette and is accomplished with their MARK command. The whole process lasted just a few minutes and we were ready to type in our programs.

All commands and system functions are clearly delineated in the manuals, but overall, we found the documentation to be redundant. Good cross-references and examples with optional and/or required parameters are provided, but for a complicated procedure one could end up looking through two or three manuals just to make sure nothing is missed. For this reason we feel the documentation is rather poorly organized and too full of the same things said differently or in too many contexts.

Typing and editing our programs was facilitated by the system editing functions and the automatic numbering and renumbering features. We felt a user could whiz through program changes once he became familiar and accomplished with the system editor.

In preparing for the benchmark runs we frequently have to make modifications in the programs for I/O and file manipulations. For the 5120, more extensive modifications than usual were required because the display area is limited to nine inches. In our opinion, the undersized screen turns out to be the major drawback of an otherwise versatile system.

IBM's BASIC is quite comprehensive and provides a full array of features. These include:

- Immediate syntax checking, automatic line numbering and renumbering, chaining programs and carrying variable values across programs, a MERGE command, and an almost automatic printing of the text in the display.

- File referencing by file number or name, a PROC command can initiate input from a procedure file, keys on the keyboard have commands such as DIM and PRINT, which can immediately be included by pressing the command key and the key with the selected command. The separate numeric keys can be programmed for procedures or text and called from the main program.

- A full line of MAT assignment statements, including MAT GET and MAT PUT, and matrix multiplication and matrix inverse.

- Such options as presetting number comparison tolerances, a complete list of functions and internal constants such as pi and natural log.

All programs were run with output to the screen and for two programs output was routed to the printer by simply changing the channel number in the print statements. The programs were entered and stored on disk. For execution the programs were loaded into memory, the RUN statement typed and the stopwatch started when the execute key was pressed. Timing was stopped when output was complete.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500		21.4 seconds
A - 2		N = 1000		41.8 seconds
A - 3		N = 2000	1 minute	22.9 seconds
A - 4		N = 3000	2 minutes	3.9 seconds

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations on the standard CPU-intensive run but without exponentiation and square root.

A - 5	Results:	N = 500	24.9 seconds
A - 6		N = 1000	48.9 seconds
A - 7		N = 2000	1 minute 37.3 seconds
A - 8		N = 3000	2 minutes 25.5 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500	2 minutes 23.6 seconds
B - 2		N = 1000	2 minutes 43.3 seconds
B - 3		N = 2000	3 minutes 20.9 seconds
B - 4		N = 3000	3 minutes 58.0 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$

$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$

$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	35 minutes	29.7 seconds

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknown as compared to 50 in the larger run).

C - 1A	Results:	12 minutes	43.0 seconds

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- New Income

C - 2	Results:	25.0 seconds

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	1 minute 18.4 seconds

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results:	4 minutes 16.2 seconds

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results:	5 minutes 55.9 seconds

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a nine-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 134 keystrokes were required to edit a nine-record text file according to the script.

IBM 5120: PRICING COMPONENTS

COSTS

IBM 5120 (as tested) $13,705

The IBM 5120 includes:

- Single desk-top unit
- 9-inch, 1024 character video display
- Attached typewriter keyboard with separate 10-key pad
- Two 1.4 megabyte disk drives
- 5103 Model 12 120 character-per-second printer
- BASIC language
- BASIC sort package

Components

- 5120 32K system with BASIC $10,305
- 5120 32K system with BASIC and APL $10,775
- Model 12 printer ..... $ 3,070
- BASIC sort package ..... $ 360
- Optional maintenance agreements:
  32K system $89.50/month
  Model 12 printer 44.50/month
  BASIC sort package 2.00/month
- 5114 add-on floppy disk drives,
  first drive ..... $ 3,445
  second drive ..... $ 1,710
- RS232C interface ..... $ 90
- Additional RAM in 16K increments ..... $ 785

OUR OBSERVATIONS

The 5120 is a purchase only (no leasing options) product and is sold through IBM's internal sales network. The unit is shipped to the user ready for his installation. Maintenance agreements are optional and provide service on an as-needed basis. The BASIC file sort package is not optional.

USER COMMENTS

- *It's a good system for a small business.*
- *We're doing a 12 million dollar business with a little micro.*
- *For the money it is an excellent system.*

IBM 5120: HARDWARE COMPONENTS

CENTRAL UNIT .... The 5120 computer is a compact full function computer that contains the CPU, keyboard, CRT and two 8-inch floppy disk drives in one 23" x 15" x 21" desk-top unit.

CPU Memory: Memory can be tailored to a variety of needs: from 16, 32, 48 or 64 thousand characters.

CRT/Keyboard: The attached keyboard includes function keys, a separate ten-key numeric pad with keys that are programmable for user defined functions and calculator function keys that add, subtract, multiply and divide. The 9-inch CRT displays 1024 characters in grey phospher.

OUR OBSERVATIONS

The 5120 is a compact, attractive unit with a high quality keyboard that combines features that make it "friendly" to the user. The screen is small and although a user becomes accustomed to the size, it can be cumbersome to program around. The system is a little noisy because the mechanical parts including the drives and fans are located right at the user's workstation.

USER COMMENTS

- *Screen size is not a factor, it's not as tiring as people think. I can program the numeric keys--that's a great plus.*
- *A good feature is the small size, we have a small room.*
- *Screen is too small, but the keyboard is excellent.*
- *32K bytes is a problem now and then.*
- *Speed is pretty good, backing up is slow.*
- *Speed is suitable for our applications.*

IBM 5120: HARDWARE COMPONENTS

STORAGE

The 5120 comes with two built-in floppy disk drives and together they hold 2.4 million characters of information using double-density, double-sided 8-inch disks. Optional add-on disk drives are available for 1.2 megabytes or 2.4 megabytes additional storage. Special features include direct access, multiple open files (ten maximum) and media exchange capability.

OUR OBSERVATIONS

We feel a drawback of the 5120 is its limited expansion capability. Many other systems on the market in the same price range offer users flexibility and growth potential that is just not available on the 5120. It is not only the amount of storage available but also the media used which can be beneficial; in many cases using hard disk storage gives faster access times.

USER COMMENTS

- *Data storage capacity is a very serious problem.*
- *For what we're doing storage capacity is not a problem.*
- *Negative factor is limited expansion, IBM does not give you anything to go to.*
- *Its best feature is the large disk capacity.*

OTHER DEVICES

5103 Model 12 Printer
- 120 characters-per-second
- 132 print positions
- Bidirectional
- Upper and lower case
- Vertical spacing under program control
- Up to six carbon copies

5103 Model 11 Printer
- 80 characters-per-second

BASIC Sort Package
- Sorts disk records in ascending or descending sequential order, creates a new disk with sorted records, or a disk file containing just the addresses of the sorted records (address out sort).

Communications Adapter
- Asynchronous or Bisynchronous

Serial I/O Adapter - RS232C
- For use with plotters, graphics display, card readers, printers or instrumentation devices.

OUR OBSERVATIONS

A nice feature of the Model 12 is the vertical spacing from program control which saves some steps for the operator. Users with business applications will appreciate the multiple carbon copy capability. On the other hand, the Model 12 printer was too slow for most of the users; however, with the RS232C adapter it is possible to attach a faster, non-IBM printer. One user we interviewed had a communications adapter that was working very well for him.

USER COMMENTS

- *The worst feature is the printer, it slows us down sometimes.*
- *The printer is slow but dependable.*
- *The printer is above average.*
- *The printer is the bottleneck of the system.*

IBM 5120: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	The 5120's operating system is transparent to the user and does not use a job control language.
Languages:	BASIC (as tested), APL
Utilities:	The BASIC sort feature sorts records in ascending or descending sequential order, creates a new disk of sorted records or creates a disk file containing the sorted records addresses (address out sort). IBM provides a diagnostic disk that has map functions to trace and diagnose hardware problems.
File Access Methods:	Sequential, Indexed Sequential, Direct

OUR OBSERVATIONS

The user is not aware of the operating system and controls the system through BASIC. Programming is greatly facilitated by the function keys and programmable functions keys which can be made to alert the operator, include text, or execute procedures. The 5120's file commands are executed by simply depressing CMD (command) key and a key on the keyboard with a command statement printed on it. These include LOAD, SAVE, CHAIN, RUN and MARK. MARK preallocates sequential file space and names files.

USER COMMENTS

- *BASIC is incredibly powerful.*
- *BASIC is good, not that many instructions are required to use it.*
- *BASIC is great. There's an interpreter in there somewhere and I don't have to compile it--that's a great plus.*
- *There is some slow disk accessing. It is extremely slow with OPEN and ALL commands.*

IBM 5120: SOFTWARE COMPONENTS

IBM SUPPLIED PACKAGES

IBM offers many application programs including:

- General Ledger
- Payroll
- Billing
- Client Accounting/Time Management
- Construction Payroll/Job Costing
- Accounts Payable
- Accounts Receivables
- Inventory Reporting

The user rents the package on a monthly basis from one to two years and at the end of the rental period he owns the license. IBM also provides a toll-free number (hot-line) that a user may call for application support.

OUR OBSERVATIONS

Most of the users we surveyed were using packages and four had BRADS II (Business Report Application Development System II) package. IBM provides an installation package along with the application program for users to install the package themselves and make modifications. This will provide a cost savings to a company but we feel the end-user who will benefit most is one who already has some computer background and has the time to make program changes. Also the rule rather than the exception is that application packages usually do need modification for any one organization using it.

USER COMMENTS

- *We have accounts payable--haven't had time to work it out.*
- *We have BRADS II and other programs. I like BRADS very much, overall they're okay packages, but we're growing too fast for them.*
- *BRADS II is satisfactory. We can do better programs on our own, but for people who don't know programming it's fine.*
- *IBM claims anybody can install applications, but I don't think that's true. Whatever their manuals are lacking their hot-line takes care of.*
- *Had some problems with IBM packages, but we get excellent support.*

IBM 5120: SOFTWARE COMPONENTS

EDITOR

The editor is cursor oriented and has a flashing underline to indicate its position. Pressing the command key and the insert or delete key will insert or delete spaces or characters. There are also up and down arrows that allow the user to go to another line.

OUR OBSERVATIONS

The editor was most efficient for correcting errors soon after they were made, in a sequential order and of material that was still on the screen. "Listing" a line number caused a listing of 14 lines above and including the line specified in order to get a display of the lines actually needed.

The editor doesn't scroll lines on the screen, but it will fill the screen and then the user can advance lines from the bottom. Once the user advances in the opposite direction, however, he cannot recover the lines that scrolled off the screen without "listing" them again. The users we talked to didn't comment on the system editor.

IBM 5120: SUPPORT SERVICES

DOCUMENTATION

IBM's documentation is quite thorough--but almost too thorough. There are two or three references to a command or statement in as many manuals; and although good examples and required or optional parameters are provided, we tended to look up all the references just to make sure we didn't miss anything. Some users said the documentation was written for people who already knew about computers and in that respect it was too technical. Better organization and more thorough explanations of system usage would probably increase the usefulness of the documentation.

MAINTENANCE

IBM provides maintenance contracts charged on a monthly basis. Service will be provided on an as-needed basis without regularly scheduled preventive maintenance. Engineering changes would also be automatically applied to the system. About half (three) of the users we talked to did have hardware problems with the system.

TRAINING

The system is shipped to the user ready for his installation of both the software and hardware. IBM does offer for no-charge one-day operator training sessions for both hardware and programming. The toll-free hot-line is geared to application support.

USER COMMENTS

- *Documentation is adequate, but you need a basic understanding of a computer to use it. Training: plugged it in and ran it.*
- *Documentation is not descriptive enough. I have to go to too many references.*
- *Documentation is good to excellent. Training was not required.*
- *We've had super service from IBM representatives. That's the best part of the system. Training was really good.*
- *IBM software support is excellent. They have a hot-line that's terrific.*

SUMMARY OF USER COMMENTS

Using names supplied by the Association of Computer Users, we contacted six users of the IBM 5120. (Although asked, IBM declined to provide us with the names of current users we could interview.) The users we surveyed had the system from two months to one year and were using it for a wide range of applications including standard accounting procedures, financial reporting, compiling budgets and reports, inventory control, cost estimating and some mathematical applications. Most of these firms were small manufacturers, one was an industrial bank and one was a health services agency. Two to five individuals in these companies used the 5120 an average of five hours a day, five days a week.

Before buying the 5120 most of the users had evaluated the range of better known computer systems including those manufactured by Cromemco, DEC, Honeywell, Phillips, Wang and NCR. Some of their reasons for choosing the IBM were software supplied by IBM, IBM's service network and price.

The standard hardware configuration was 32K central memory, 2.4 megabyte floppy disk drives, and the Model 12, 120 character-per-second printer. One user had 64K central memory and another user had IBM's communications attachment. Overall, the hardware was reliable but three of the users had problems that included clogged disk drives, power supply failures and lost data and memory. These users felt IBM gave tremendous service but one individual said they were "prompt but ineffective in diagnosing problems."

Only two of the users were developing and maintaining their own programs in-house. The others had IBM's BRADS II and other IBM supplied application packages. Generally, these people found BRADS II satisfactory, although one user said his firm was growing too fast for the software and another user felt he could "do better programming on his own, but for people who don't know programming, BRADS is fine." Users said that while they might have some problems with the software, IBM's software support was excellent.

IBM's documentation was viewed by some users as "okay" or "pretty good." Others said it was "not the best," and that they had to go through too many

manuals or already have a basic understanding of computers to use them. But several users said IBM's hot-line resolved their questions when the documentation didn't.

The users liked IBM's implementation of BASIC and one user said that, "It was incredibly powerful." They felt its advantages included string and matrix operations and that it was interpretive. One user thought it was a bit "clumsy" because he could not "invoke system commands" or have "multiple statements on a line." When asked about system speed the users' consensus was that it was "suitable for their applications." One user did say that it was very slow for some disk accessing, especially when the OPEN and ALL commands were invoked.

The 5120's keyboard was considered "excellent" and users especially liked the ten-key numeric pad and programmable keys. The screen, on the other hand, was too small for most of the users; though one user said, "It's not as tiring as people might think." Most of the users felt the printer was too slow and the "bottleneck" of the system. Users did agree that it was dependable.

All the users had just the two disk drives and for their applications 2.4 megabytes was "adequate." For one user though, not being able to expand to hard disk was a serious drawback of the 5120. All but one user had 32K central memory and found that for the most part, it was big enough for their application programs. One of these people said it was occasionally a problem and when core was overloaded, he found conversion errors in his results.

For some of these users, the 5120's rigid configuration was a serious handicap. They wished they could add hard disk or terminals or that there was an alternative to the small screen. This was discouraging too because there was a big jump in price to another larger IBM system. The keyboard and BASIC were positive aspects of the system while the slow print speed and small screen size generally hampered usage of the 5120. These users did like the IBM 5120 despite these drawbacks. Asked for their overall evaluation of the 5120, the users we surveyed said it was a good system and "for the money it's excellent."

CONCLUSIONS

The IBM 5120 is a compact and friendly little system. Its fast times on the CPU-intensive program with square root and exponentiation show it has good intrinsic mathematical functions but the poor showing on the alternate CPU-intenstive and the scientific/engineering programs indicate that its overall computational ability is weak. The 5120 also came in with some of the slowest systems we have tested on all of the other benchmark runs.

Outstanding features of the 5120 are IBM's image based on solid user support, a versatile and high quality keyboard and a powerful BASIC with many matrix operations. Additionally, IBM furnishes many application programs but implementation and modifications are left to the user. The 5120 is not a turnkey product and a user could incur extra expense getting packages on-line. The potential buyer must also keep in mind that the system cannot be expanded and he must be doubly sure of his company's projected growth.

The 5120 is encumbered somewhat by its small screen and the slow printer. The screen size is less of a problem though than the printer. Although it is dependable it is probably packaged with the wrong system since it turns out to be a serious bottleneck of system throughout.

The 5120's good features outweigh its drawbacks but the strong points of the system will depend entirely on the user's applications. Since it is being used mainly in small firms for standard business procedures, software packages and size of the data base become key concerns. IBM does provide software and indirect software support, but the software's usefulness will be based on variables such as the firm's accounting procedures and users' knowledge of computers and programming.

At $13,705 we feel that the 5120 is somewhat overpriced. It must be viewed as a simple, floppy based system without dynamic capabilities. The user is buying IBM's image which is backed by a solid service organization where users will find a consistency across IBM representatives. But depending on a user's computer background and procedures, program modifications of packages by a third party programmer might be necessary since IBM does not tailor packages for the users.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

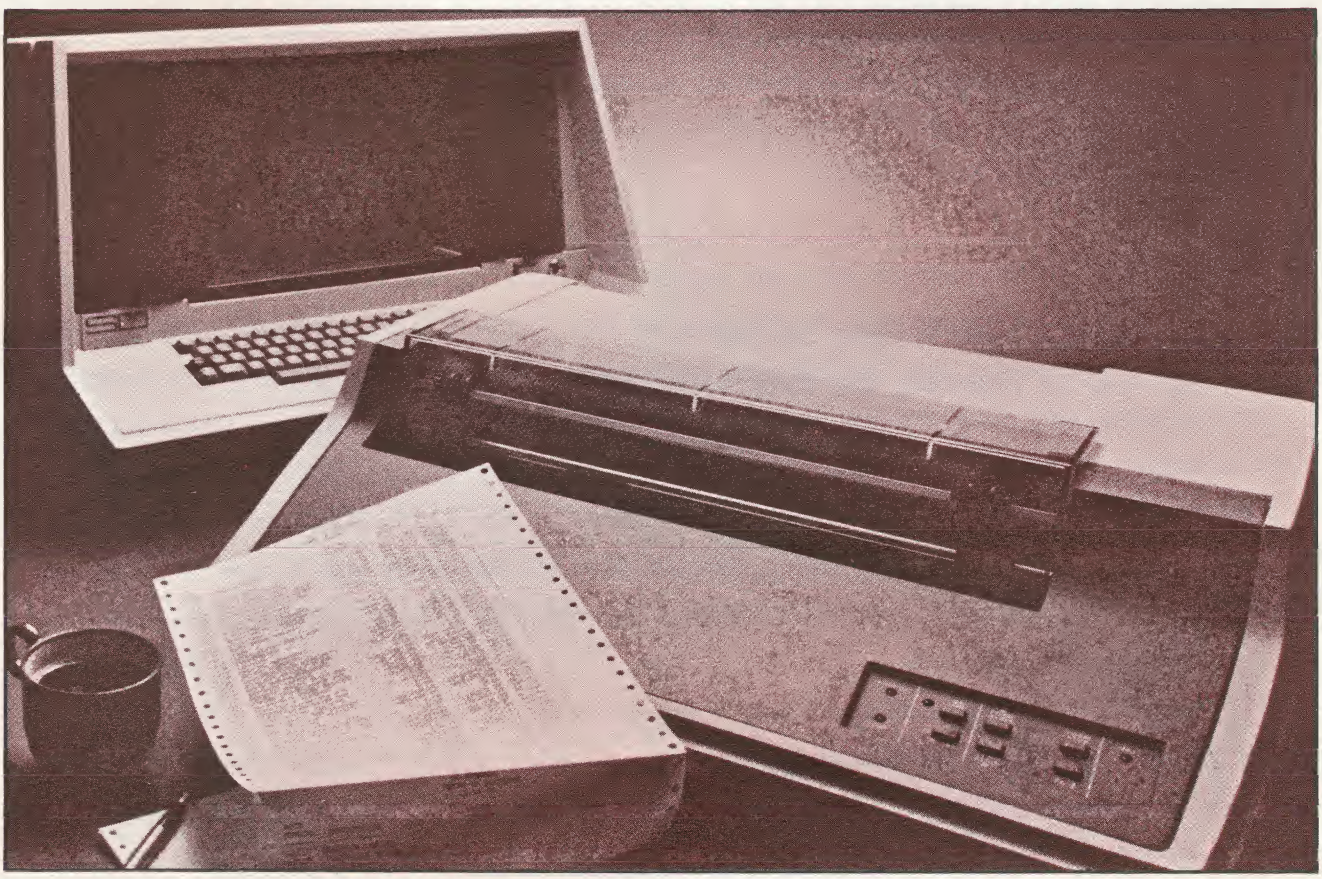
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 2, JUNE 1981



In This Issue:

The SD SYSTEMS SD-200

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

SD SYSTEMS SD-200: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: SD Systems SD-200	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

This report on SD Systems' SD-200 is the second report in our continuation of Series 1 and 2. Included in this Series are systems designed mainly for single users and costing under $25,000. The SD is priced at $12,300, as tested, and can be expanded to a multi-user, hard disk based system.

The heart of these reports is the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. The results of these benchmark runs provide comparative information which is simply unavailable from any other independent source. The benchmark programs themselves have been designed to run without change on most small computer systems. Thus, differences in performance among systems can be attributed to differences in computing capabilities.

In addition to the benchmark results, these reports contain information on the alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on the ease of use of the system. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report. The experiences of users add a dimension of reality to the technical details of the system.

Information provided by manufacturers can often be difficult to interpret and sometimes misleading. While some of the potential buyers of microcomputers have some background with computers, the majority we've surveyed are buying their first computer, and often the personnel using it will not have had much direct experience with computers. We feel these reports are invaluable to experienced and inexperienced users alike by providing an unbiased assessment of some of the microcomputer systems on the market today. Our results, which are comparable across computer systems, and our observations of the system in a "real world" setting can help potential users intelligently select a system that is best for them.

EXECUTIVE SUMMARY

The SD-200, priced at $12,300 as tested, consists of a 12-inch video display, a typewriter keyboard with separate numeric keypad, two Qume 8-inch floppy disk drives with 2 megabytes of formatted storage, two Z80A processors, 64K bytes of central memory, an S-100 bus and a RS232 interface. All of this is contained in a single desk-top unit with a Texas Instruments 810 150 character-per-second printer. The SD-200 offers expansion capabilities to five users, and up to 96 megabytes hard disk storage with the addition of SD's COSMOS operating system.

- Compared to the 25 systems we've tested so far, the SD-200 performed very well on the I/O-intensive and Product Planning Model programs and in the middle of the systems on the other benchmark runs.

- The operating system, SDOS, provides a full range of file and disk manipulation utilities. BASIC-80 (by Microsoft) allows both random and sequential file access.

- SDOS, the SD Operating System, is CP/M (Digital Research operating system) compatible. As a result, the SD user has full access to the many software packages and languages developed for systems running CP/M.

- With its two Z80A processors, the SD-200 is following the trend toward systems with multiple processors dedicated to separate tasks. However, SDOS and associated utilities do not take advantage of this design. One of the processors, used on the video board, is, in our opinion, being greatly underutilized.

- We found the documentation hard to use, incomplete and poorly organized. Many of the users we talked to had similar complaints about the manuals and also felt that its language was too technical. SD does provide complete diagrams and text for their hardware and mechanical components, but this information could only be useful for very knowledgeable computer users concerned with the hardware aspects of the machine.

- We surveyed 12 end-users of the SD-200 who reported that the hardware was generally reliable; some users experienced startup problems but the system was now running without problems. Service from the dealers was fair to good.

The SD-200 is a microcomputer that provides some special hardware features and compatibility with a wide range of application software now on the market. The hardware is reliable and the service is good, though users can become too tied to dealers because of poor documentation.

BENCHMARK REPORT

SYSTEM: SD Systems SD-200

PRICE AS TESTED: $12,300

SPEED TESTS

Benchmark Number	*CPU INTENSIVE*	TOTAL TIME Min.	Sec.
A-1	N = 500		39.6
A-2	N = 1000	1	17.4
A-3	N = 2000	2	23.0
A-4	N = 3000	3	48.8
A-5	N = 500		11.0
A-6	N = 1000		20.4
A-7	N = 2000		39.1
A-8	N = 3000		57.8
	I/O INTENSIVE		
B-1	N = 500	1	7.8
B-2	N = 1000	1	15.0
B-3	N = 2000	1	30.9
B-4	N = 3000	1	49.3

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	17	42.8
C-1A		6	25.9
C-2	NEW PRODUCT PLANNING		10.5
C-2A			40.9
C-3	ACCOUNTS RECEIVABLE	6	16.4
C-3A		7	3.6

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	208
E-2	SUBJECTIVE JUDGMENT	Easy

THE BENCHMARK PROCESS

The Benchmark programs were run using Microsoft's extended BASIC-80 under the SDOS operating system. We tested the single desk-top unit which contained two double-density, double-sided disk drives (2 megabytes storage), a 12-inch video display terminal, an attached keyboard with separate numeric pad, 64K central memory, and the TI 810 printer with serial interface. The system utilities, operating system, BASIC-80 and the Benchmark programs were contained on one disk.

The system was shipped to our offices in Boulder, Colorado, from SD Systems in Dallas. It was not immediately operational and two boards had to be replaced. Once new boards were snapped in the system was ready to go. It required no "personalization," although a unique user configuration is possible with the MAKSDOS command. A technical representative from SD Systems spent two days familiarizing us with the system and observing our benchmark procedures.

Unfortunately, SD's documentation was not as polished as some we've seen, mainly because it assumes prior computer knowledge on the part of the user. Some confusion is caused by some command processes that are duplicated under different system modes. For instance, DIR (an "internal" command) and XDIR (a utility) both list the files, their extensions, amount of memory each used and total files and memory used, but DIR also lists extension attributes and XDIR lists these files in four columns while DIR lists them in one continuous column. Under the section on Special Purpose System Calls is not clear at all what the user must enter in order to use these calls. Streamling utilities and grouping together similar commands with a note to their differences and recommended usage, rather than providing only a cursory listing of system commands, would go a long way in helping the SD user. However, the hardware features of the system are well documented, and have text that accompanies complete diagrams. We understand that SD is currently working on a revision of their documentation.

We chose to use the system Text Editor instead of the BASIC-80 editing functions to type in the Benchmark programs, and because BASIC-80 is such a standard form of BASIC, virtually no modifications to our programs were required. BASIC-80 is also interpretive and when we finished typing and editing, the programs were ready to be run.

We used the extended version (5.1) of BASIC-80 which has features not found in earlier versions such as variable names with up to 40 significant characters and double precision numbers. Other features include:

- Error trapping capabilities along with the ability to trace execution of program statements,
- Mathematical functions such as LOG, TAN, and absolute value, exponentiation, and floating point,
- User defined functions, type conversion, including numeric to string and vice versa, logical operators, a COMMON command, chaining and merging of programs and CALLs to assembly language subroutines,
- Structured language features: IF...THEN...ELSE, IF...GOTO, and WHILE...WEND, and
- String, numeric, fixed point, and floating point constants and automatic and renumbering of lines.

All programs were run with output to the CRT screen. For those programs having printed output, we changed all PRINT statements to LPRINT which directed output to the printer. The programs were entered, edited, and stored on disk. To execute, they were loaded into memory, the RUN statement typed in, and the stopwatch started when the carriage return was pressed. Timing was stopped when output was complete and/or the program terminated normally.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

The short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500	39.6 seconds
A - 2		N = 1000	1 minute 17.4 seconds
A - 3		N = 2000	2 minutes 23.0 seconds
A - 4		N = 3000	3 minutes 48.8 seconds

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500	11.0 seconds
A - 6		N = 1000	20.4 seconds
A - 7		N = 2000	39.1 seconds
A - 8		N = 3000	57.8 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrives the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500	1 minute	7.8 seconds
B - 2		N = 1000	1 minute	15.0 seconds
B - 3		N = 2000	1 minute	30.9 seconds
B - 4		N = 3000	1 minute	49.3 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$

$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$

$$\vdots$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	17 minutes 42.8 seconds

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results:	6 minutes 25.9 seconds

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

C - 2	Results:	10.5 seconds

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	40.9 seconds

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results:	6 minutes 16.4 seconds

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results:	7 minutes 3.6 seconds

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a nine-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 208 keystrokes were required to edit the nine-line test file.

Comment: The Ease of Use test was done using BASIC-80's editor.

SD-200: PRICING COMPONENTS

COSTS

SD-200 (as tested) $12,300

SD-200 includes:
- Single desk-top unit
- Two Z80A processors
- Two 1 megabyte 8-inch Qume floppy disk drives
- 64K bytes central memory
- Typewriter keyboard with separate 10-key pad
- 12-inch screen with reverse video
- One serial and one parallel input/output ports
- TI 810 printer with serial interface
- CBASIC
- Microsoft BASIC-80

Components

SD-200 (without printer) ..... $ 9,700

TI 810 printer with serial interface ..... $ 2,250

Microsoft BASIC-80 ..... $ 350

OUR OBSERVATIONS

The SD-200 is marketed through SD's network of dealers in the United States and abroad. Dealers provide training for both the hardware and software.

USER COMMENTS

- *If I had it to do all over again I'd buy the same thing.*
- *We're very happy with the system; it was simple to implement.*
- *We wore out the disk drives, but got excellent service. I like the performance of the machine very much. Speed is a drawback but that will be taken care of when we get a hard disk.*
- *The SD is good; it's reliable. Probably a little expensive for what's on the market, but I'm not sorry I bought it.*

SD-200: HARDWARE COMPONENTS

CENTRAL UNIT .... The SD-200 is a single, metal encased, desk-top unit which includes two Qume 8" floppy disk drives for 2 megabytes on-line storage, a 12-inch video display, and a typewriter keyboard with separate numeric pad. With the addition of the COSMOS operating system it can have 4 terminals added to it with serial interface and up to 96 megabytes hard disk storage.

CPU Memory: The SD-200 comes with 64K central memory which can be expanded up to 256K after adding the COSMOS operating system.

CRT/Keyboard: The 12-inch video display is driven by a video display controller board with its own Z80A processor. The keyboard and ten-key numeric pad are attached to the unit.

OUR OBSERVATIONS

We found the system to be simple and easy to operate. The unit itself is solid and durable looking. The keyboard has a nice tactile touch that makes it easy for an operator to key-in by touch. A bothersome side-effect of self-contained units is the noise of the drives and fans at the operator's work station. The SD was no exception but users we talked to did not comment on the noisiness of the system.

The implication of having a Z80A processor on the video display board is that the CPU can be used almost exclusively for processing and not be interrupted to refresh the screen or control I/O. It is also inherently flexible because it is programmable, yet the system does not provide cursor positioning or scrolling. For these reasons we feel the system has a potential that is not taken advantage of by the operating system and utilities.

USER COMMENTS

- *It's fast. We can tell who owes us what in no time.*
- *It could be faster. It slows down with one terminal added, but it's not a problem, just irritating. It wouldn't do that if we had a hard disk.*
- *We've had very little hardware trouble.*
- *Central memory is adequate. It's faster than most we've looked at.*

SD-200: HARDWARE COMPONENTS

STORAGE

SD's disk controller board, called Versafloppy II, can handle up to four drives for a total on-line storage capacity of 4 million characters of information. Versafloppy II is soft sectored and has IBM 3740 compatible formatting capability. It also performs cyclic redundancy error checking and can transfer data between any combination of media, that is, single-sided to double-sided, single-density to double-density, etc.

By first incorporating the COSMOS (multi-user) operating system, a user can add from 32 megabytes to 96 megabytes hard disk. Price for a 32 megabyte add-on package with Phoenix drives is $13,000.

OUR OBSERVATIONS

One of the special features of the SD is its expandability, providing flexibility and a long-term computer system to end-users. Several of the users did anticipate needing hard disk capability soon, but for the majority, 2 megabytes of storage was adequate for their needs. Users found the drives to be reliable and requiring very little service.

USER COMMENTS

- *It's worst feature is its lack of storage capacity, it's not designed for a user using it as much as we do.*
- *Data storage is okay now, depends on our growth.*
- *Two megabytes is fine, stored a whole year for us.*

OTHER DEVICES

Printer: Texas Instruments 810

Bidirectional 150 character-per-second
132 characters per line
64 character ASCII set
Dot matrix impact

Many optional features are available such as a full ASCII 95-character set, European character sets, and line buffer boards.

OUR OBSERVATIONS

The TI 810 is an excellent microcomputer industry standard printer and the many users we have talked to have testified to its great reliability. It is further enhanced by the options offered by Texas Instruments.

USER COMMENTS

- *Printer seems to double print and skip, but the speed is excellent.*
- *The printer is great.*

SD-200: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	SDOS
Languages:	BASIC-80 (as tested), CBASIC II, CIS COBOL and other CP/M compatible languages
File Access Methods:	Sequential, Random

UTILITIES

File Manipulation:	For file management SDOS has system and utility commands that display file status in Hex and ASCII code, designate files as protected, lists files and file extensions and renames and deletes files and copies files and file areas.
System Management:	System management covers I/O, disk and memory control. A user can software program baud rates, change I/O default devices, copy disks and the operating system, obtain disk status, and format, read and write disks. Through the SD Monitor the user can move, display, modify blocks of memory and make a RAM test.
Debugging:	Capabilities for debugging include input/output control and examination of ports, examination of registers, setting breakpoints and single stepping through programs.

OUR OBSERVATIONS

The SD offers a full range of system and file management capabilities. Microsoft's BASIC-80 is fairly powerful and allows structured programming with random access an added plus. It is also interpretive which will facilitate program development; however, no matrix operation commands are available.

USER COMMENTS

- *CBASIC and BASIC-80...very discouraged by both. CBASIC is too slow.*
- *CBASIC works real well.*
- *CBASIC is nice because it's portable.*

SD SYSTEMS SUPPLIED PACKAGES

SD supplies a general business application package called Exchequer which includes:

- General Ledger
- Accounts Receivables/Payables
- Inventory Control and Invoicing
- Payroll
- Fixed Assets
- Cash Receipts
- Cash Disbursements

SD's operating system is compatible with software developed for the CP/M operating system and SD supports many packages developed for special markets such as surveyor's, CPA's, property management, sales invoicing, direct mailing, and the word processing package Word Star.

OUR OBSERVATIONS

We did not use Exchequer but obtained details about it from SD's brochure. Some of the subsystems' capacities are in the range of 1500 customers and/or open accounts requiring 48K or 2000 customers with 64K. Specifications can be expanded by using more disks. Only one of the users surveyed had Exchequer and he felt that it was very basic. Three of the users had Word Star and reported they had no problems with it.

We talked to a computer dealer who sells CP/M application packages and he estimated there are 500 CP/M compatible packages and ten languages on the market--a lot of flexibility for the SD user.

USER COMMENTS

- *Best feature is its word processing capability.*
- *I like Word Star reasonably well.*
- *Word Star is great. I like it better than Word Master.*
- *CP/M derivatives are all miserable.*

SD-200: SOFTWARE COMPONENTS

EDITOR

SD's Text Editor is called from the system with the EDIT (and filename) command. A new file is opened and named at that point. It is line oriented and there are global search and change facilities, exchange old lines for new lines, merging of blocks or lines of text with other files and a command to inhibit display following certain commands for use with slow devices. A Q command ends the editing session and automatically saves the edited material.

Under BASIC-80, the editor is line oriented with no global change capabilities. Editing is accomplished by typing the command EDIT followed by a line number. A series of subcommands are then used to move the cursor, display the lines, and insert, delete, find and replace text.

OUR OBSERVATIONS

We found the system to be simple and easy to operate. The unit itself is solid and durable looking. The keyboard has a nice tactile touch that makes it easy for an operator to key-in by touch. A bothersome side-effect of self-contained units is the noise of the drives and fans at the operator's workstation. The SD was no exception but users we talked to did not comment on the noisiness of the system.

USER COMMENTS

. *I use Word Star for editing.*

DOCUMENTATION

From an end-user's viewpoint we found the documentation hard to use. It contains the necessary information for using the utilities, doing a sysgen, linking, etc., but finding this information is a time consuming and arduous task. In our opinion, procedures are presented in a rather vague and unclear fashion. We agree with the users who felt that it was poorly organized as a resource for system usage. On the other hand, hardware details of the system are well documented with diagrams and text.

MAINTENANCE

The system is shipped to the user or dealer with a 120 day warranty which the user's dealer will honor. Any other service agreements are made between the dealer and user.

TRAINING

A five-day training course is given to dealers in Dallas who may bring along end-users. However training of the end-user is generally provided by the dealers.

USER COMMENTS

- *Documentation is fine; training stunk, could do it ourselves.*
- *Documentation could be better. Training was fair, once a day for two weeks.*
- *The whole system documentation could be expanded. It's written for people who already know a lot about computers.*
- *The documentation is almost worthless. It tells what the computer is capable of and doesn't tell how to get results from the computer.*

SUMMARY OF USER COMMENTS

With names supplied by SD systems, we contacted twelve end-users of the SD-200. These firms included machine shops, manufacturers, wholesale distributors, and several tax and bookkeeping services. The majority were using the SD for standard accounting procedures and inventory control, the machine shops were using it for job costing and scheduling. Two users were also using it for word processing and one user had mathematical applications. These users had the system from five months to a year and a half. About three people in each firm used the system an average of five hours a day, five days a week.

The standard hardware configuration consisted of the 2 megabyte floppy disk drives, a TI 810 printer and 64K to 192K central memory. Over half the users were unaware of how much RAM they had and no one was using a hard disk. Other printers in use were the NEC Spinwriter, the Diablo and the Paper Tiger. Three of the firms surveyed had from 1 to 4 additional terminals.

Hardware reliability for the SD was generally quite good. Some users reported some initial start-up problems but "once we were operational we haven't had any problems;" and others reported they had had no hardware problems whatsoever. When service was required most users said that it was good, but two users rated hardware service as only "fair."

The screen, keyboard, and printer were working very well and only caused minor inconveniences for three of the users. A typical comment was, "the keyboard and screen are fine, the printer is great."

For data storage capacity these users generally felt 2 megabytes of on-line storage was "adequate," while two users were sure they would need a hard disk soon. The following comment sums up these users' storage requirements, "Data storage capacity is okay now, depends on our growth."

The operating system was transparent to most of the users and very few of them made any substantive remarks about it. Three of the users didn't know which form of BASIC they were using but the rest were running their programs in

CBASIC and one user was using FORTRAN. Users answered only briefly when questioned about CBASIC. They said, "I love it," or "it works well."

Very few of the users had purchased either SD's or CP/M application packages. Three users had Word Star and one of them also had Exchequer. These users liked Word Star and the user with Exchequer thought that it was very basic. Another user was quite happy with his SD but said, "CP/M derivatives are all miserable."

The users with four additional terminals didn't have all of their programs on-line yet and planned on using their terminals for data-entry or inquiries. The user who had one additional terminal said his system did slow down but not enough to be a problem. In general, these users felt system speed was "fine" and that the SD "saved them time."

Most of the users we surveyed did not like SD documentation, but one user (out of the 12 surveyed) said the documentation "was fine, and written well." Some criticisms of the documentation were that it was too technical, told what the computer could do but didn't tell how to get it to perform these functions, and that it takes a long time to find answers to their questions. Most of the users were happy with the software support they received from their third party programmers, but one user felt their support was only "fair to poor, and he really had to get on them to get things done."

Despite any drawbacks users felt the SD-200 had, they were generally happy with their systems and, except for the users who would soon need hard disk capability, the capacity of the systems fit their size and filled their application needs. For these users it had been an easy system to implement and simple to learn and to operate. The hardware was proving to be reliable and service was good, as were user-dealer relationships. Here are some final comments from two pleased SD users. "If I had to do it all over again, I'd buy the same thing." and, "It's not that hard to learn, it's doing everything we've taken the time to set it up to do."

CONCLUSIONS

The SD-200 was a solid performer in our benchmark programs. Running in BASIC-80 the times were right in the middle of the other 25 systems tested so far, and among the fastest for the I/O-intensive and New Product Planning Model programs.

It is designed as a single-user system but is easily expandable to five users, 96 megabytes hard disk and 256K central memory. The end-users we contacted had found a good match between the system and their applications, and found the hardware and service to be reliable and good.

The SD-200 operating system is CP/M compatible which makes an enormous variety of software packages and languages available to the SD user. Even if the packages turn out to require modifications, they cut programming expenses by avoiding total custom software.

With its two Z80A processors the SD has the potential of being a powerful system but we didn't feel the operating system was designed in a way that optimized the SD's hardware features; and without more complete documentation, it would take a very knowledgeable user to fully utilize system features.

On the plus side, the ability to expand the SD-200 to a multi-user system and the ability to add a hard disk are the outstanding features of the system and contribute to its versatility. With these expansion capabilities and the software components that are available through its CP/M compatible operating system, the SD is a good all-around computer system. The SD's performance on our benchmark runs indicate that it is a capable performer for both business and math or engineering applications, and we feel it is a microcomputer worth considering for small and growing businesses.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

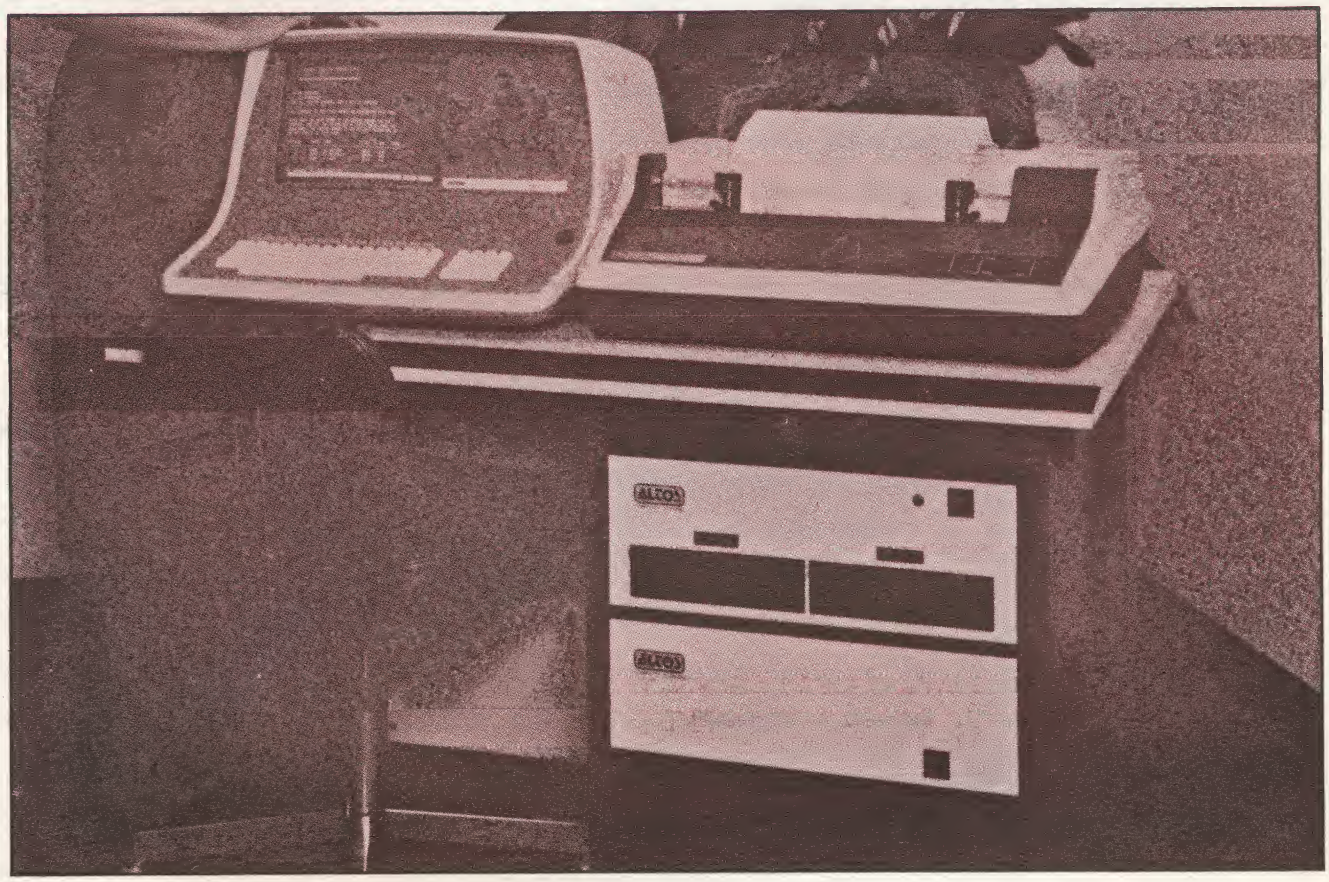
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 4, AUGUST 1981



In This Issue:

The ALTOS ACS8000-15 and ACS8000-6

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

ALTOS ACS8000-15 AND ACS8000-6: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: ACS8000-15 and ACS8000-6	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

The Altos ACS8000-15 and ACS8000-6 microcomputer systems are the subject of our fourth report in this series of Benchmark Reports. This series, the continuation of Series 1 and 2, evaluates systems designed principally for single users and costing under $25,000.

As our experience has grown (this is the 28th system covered by ACU in this price range), we often reflect on the variety of approaches we've seen computer manufacturers take in "solving" the business data processing "problem." We've seen integrated systems, multi-vendor component systems, "souped up" small systems, "toned down" larger systems, floppy-based systems, hard disk capabilities, systems using similar operating systems and processors, and so on. Yet, even with all of these differences, we've seen many similarities in system architecture, marketing philosophy, and in many other areas.

With such diversity abounding in the computer field, many prospective purchasers (especially "first-timers") are finding themselves overwhelmed by the task of sorting through all of the information presented. Though manufacturers are happy to provide information about their system, it can often be difficult to interpret and sometimes misleading. We feel these Benchmark Reports bridge this "information gap" by providing an unbiased assessment of some of the microcomputer systems on the market today. Our results, which are comparable across computer systems, and our observations of the system in a "real world" setting, can help experienced and inexperienced users alike in intelligently selecting a system that is best for their particular needs.

The heart of these reports is the comparative results of running five benchmark programs on each system under study. These programs are designed to test capabilities needed by users in an operating environment. The results of these benchmark runs provide comparative information which is simply unavailable from any other independent source. Also contained within these reports is information on alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, and the availability of application packages. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report.

EXECUTIVE SUMMARY

The Altos ACS8000-15 as configured for our tests consisted of a Z-80A processor, 208 kilobytes of main memory, dual single-sided double-density floppy disk drives (one megabyte total), and one parallel and six serial I/O ports. Peripherals are not a standard part of the Altos system "package," but for our tests we used a Texas Instruments Model 810 printer and a Hazeltine 1420 CRT terminal. Total cost of the system was $9,875. With the addition of a 14.5 megabyte hard disk drive, the system becomes the ACS8000-6 (priced at $14,375).

- The Altos ACS8000 series of microcomputer systems are based on a single board technology. Rather than separate boards for the processor, memory, and disk controller plugged into a data bus, the ACS8000 uses one board which contains all of these components. All of the IC's (Integrated Circuits) are fully socketed so that chips can be easily replaced.

- The ACS8000 systems are not "packaged" by Altos with a specific terminal and printer. This task must be done by the user, or, as is most often the case, by the dealer.

- Perhaps one of the nicest features of the Altos ACS8000 systems (in our opinion) is the numerous storage upgrade paths available. Starting with the low cost ACS8000-15 which has dual eight-inch floppies, the user may add hard disk drives in 10, 14.5, or 29.0 megabyte increments. In addition, two more floppy disk drives or a 13 megabyte magnetic tape cartridge drive may be added. The system can include a total of 2 hard disk drives, four floppy disk drives, and a tape cartridge drive.

- The ACS8000-15 comes with 208 kilobytes of memory partitioned into four 48 kilobyte user areas and a 16 kilobyte system area. When equipped with a multi-user operating system, the machine can handle up to four concurrent users. In this report, we tested the ACS8000-15 as a single-user system only, by using the single-user CP/M operating system.

- There is a wide variety of languages available for the ACS8000 including BASIC, Pascal, FORTRAN, COBOL, APL, and PL/1. In addition, Altos offers asynchronous, synchronous, and networking communications software plus some word processing packages. Other business application software is available from Altos vendors and other firms.

- The users we contacted in our survey were primarily characterized as "first-time" and/or "turnkey" users. They bought their Altos system from a dealer as a total packaged system and were generally quite pleased with the system's performance.

The Altos ACS8000-15 provides the business user with a low cost entry into computerized data processing. With easy expansion of disk storage capacities, a multi-user capability, and a vast amount of readily available software already on the market, the Altos ACS8000 systems can offer many businesses the computer "power" they need.

BENCHMARK REPORT

SYSTEM: ALTOS ACS8000-15

PRICE AS TESTED: $9,875

SPEED TESTS

Benchmark Number		TOTAL TIME * Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500	2	24.2
A-2	N = 1000	2	43.5
A-3	N = 2000	3	25.2
A-4	N = 3000	4	05.9
A-5	N = 500	2	06.0
A-6	N = 1000	2	08.4
A-7	N = 2000	2	13.1
A-8	N = 3000	2	17.8
	I/O INTENSIVE		
B-1	N = 500	2	33.9
B-2	N = 1000	2	39.2
B-3	N = 2000	2	49.3
B-4	N = 3000	3	01.7

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME * Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	7	54.5
C-1A		4	18.9
C-2	NEW PRODUCT PLANNING	2	30.6
C-2A		3	05.7
C-3	ACCOUNTS RECEIVABLE	10	41.5
C-3A		11	36.3

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	208
E-2	SUBJECTIVE JUDGMENT	Easy

*The timings shown here are for Altos' floppy based ACS8000-15; see pages 9,11 and 12 for the faster timings with the hard disk model. Also, all timings shown here are "with compile" times, i.e., compile plus run times. See the following pages for "run only" times.

THE BENCHMARK PROCESS

All benchmarks were run using Microsoft BASIC-80 (version 5.2) under the CP/M operating system (version 2.10). The Altos ACS8000-15 is configured with a Z-80A processor, 208 kilobytes of main memory, two single-sided double-density floppy disks (1 megabyte total), and one parallel and six serial I/O ports. In addition, the system we tested used a Texas Instruments Model 810 printer and a Hazeltine 1420 CRT terminal. With the addition of a 14.5 megabyte hard disk drive, the unit becomes the ACS8000-6. We tested the system at Altos' plant in San Jose, California.

CP/M, a widely used operating system for Z-80A based systems, requires some personalization (informing the software of the hardware configuration available) before use. This was done for us by Altos personnel prior to our arrival, but previous experience by our team with the CP/M personalization routine has shown that this is not a difficult process (given average or better documentation). In most cases, unless the user plans on programming in-house, this personalization will be done for the user by the OEM from whom the system and programs are purchased.

Before the benchmark programs could be run, some modifications were needed to adapt them to Microsoft's BASIC-80. Typically, the major differences in versions of BASIC involve input/output statements, and BASIC-80 was no exception.

Our familiarity with BASIC-80 (we've seen it on a number of other machines), made the modification process an easy one. We've always felt that the BASIC-80 Reference Manual is a helpful, easy-to-use reference guide, but should not be treated as a learning tool by novice BASIC programmers. The manual is well laid out with cross-referencing between statements and numerous examples provided, though we're not sure there are ever enough examples given in reference manuals.

BASIC-80 is a widely used version of BASIC largely due to its compatibility with the CP/M operating system. Some of its programming features include:

- IF ... THEN ... ELSE and WHILE ... WEND statements that allow some structured programming.
- Automatic program numbering facility as well as a renumbering facility.

- Assembly language subroutine calls.
- Direct (or immediate) execution of statements. That is, if you type in a BASIC statement without a line number, it will execute immediately.

A criticism of BASIC-80 we have had in the past is that it does not do syntax-error checking as the statements are entered, but rather it detects the errors as the program executes. We must admit that this feature is not often found, but when it is available, it greatly facilitates program entry and development.

To run the benchmark tests, we used the BASIC-80 interpreter/editor to enter and debug the programs. We then compiled the programs using Microsoft's BASIC Compiler which produces a relocatable file (REL file). This REL file is then operated on by Microsoft's LINK-80 program which creates a loadable object code file (the file that is actually put in memory and executed). This two-step process is rather time consuming (an average of 20 seconds to compile and 2 minutes to link), but is greatly eased by the ability to test and debug the programs interactively (using the interpreter) before generating the compiled code. When we repeated the compile-link procedure using the hard disk, we found the average time cut approximately in half by the hard disk's greater speed and capacity.

All programs were run with output to the screen. For those programs having printed output, a control character (Control-P) is all that is required to route output to the printer. The programs were loaded into memory, and timing was started on entry of a carriage return and stopped when program output was complete. We report both "with-compile" (using the floppy disk during the compile/link phase) and "run-only" times so that the user might have both "production" and "program-development" times (they are the same in an interpretive environment). Which timing is of primary importance will of course depend on the particular application the user has in mind.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that use repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

			With Compile	Run Only
A - 1	Results:	N = 500	2:24.2	20.7
A - 2		N = 1000	2:43.5	41.0
A - 3		N = 2000	3:25.3	1:21.8
A - 4		N = 3000	4:05.9	2:02.4

Note: This program does not use disks (except in the compile phase), so the ACS8000-15 and ACS8000-6 times are the same.

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

			With Compile	Run Only
A - 5	Results:	N = 500	2:06.0	2.6
A - 6		N = 1000	2:08.4	5.0
A - 7		N = 2000	2:13.1	9.7
A - 8		N = 3000	2:17.8	14.7

Note: This program does not use disks (except in the compile phase), so ACS8000-15 and ACS8000-6 times are identical.

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

			With Compile	Run Only
B - 1	Results:	N = 500	2:33.9	28.2
B - 2		N = 1000	2:39.2	33.5
B - 3		N = 2000	2:49.3	43.6
B - 4		N = 3000	3:01.7	56.0

Note: When the hard disk was used, Run Only times were 13.3 seconds, 17.1 seconds, 24.0 seconds, and 31.1 seconds, respectively.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$

$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$

$$\vdots \qquad \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2 and x_N are printed at the end of the execution.

		With Compile	Run Only
C - 1	Results:	7:54.5	5:39.3

Note: This program does not use disks (except in the compile phase), so ACS8000-15 and ACS8000-6 times are identical.

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknown as compared to 50 in the larger run).

		With Compile	Run Only
C - 1A	Results:	4:18.9	2:03.7

Note: This program does not use disks (except in the compile phase), so ACS8000-15 and ACS8000-6 times are identical.

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

		With Compile	Run Only
C - 2	Results:	2:30.6	8.3

Note: This program does not use disks (except in the compile phase), so ACS8000-15 and ACS8000-6 times are identical.

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

		With Compile	Run Only
C - 2A	Results:	3:05.7	43.4

Note: This program does not use disks (except in the compile phase), so ACS8000-15 and ACS8000-6 times are identical.

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

		With Compile	Run Only
C - 3	Results:	10:41.5	3:52.7

Note: Using the hard disk option, the Run Only time was 1 minute, 35.1 seconds.

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

		With Compile	Run Only
C - 3A	Results:	11:36.3	4:47.5

Note: Using the hard disk option, the Run Only time was 2 minutes, 33.7 seconds.

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1	Results: Approximately 208 keystrokes were required to edit a nine record test file according to the script.

Comment: The Microsoft BASIC-80 editor is not very efficient in terms of required keystrokes, but it is easy to use. The commands are not difficult to learn or remember.

ALTOS ACS8000-15 AND ACS8000-6: PRICING COMPONENTS

COSTS

Altos ACS8000-15 (as tested, including software)..... $ 9,875
Altos ACS8000-6 (with hard disk)..... $14,375

The ACS8000-15 (as tested) includes:

- Z-80A processor
- 208 kilobytes of main memory
- Dual single-sided, double-density floppy disk drives (1 MB total)
- One parallel and six serial I/O ports
- CP/M operating system
- Microsoft BASIC-80 and BASIC Compiler
- Texas Instruments Model 810 printer
- Hazeltine 1420 terminal

The ACS8000-6 (as tested) includes:

- All of the above items
- A 14.5 megabyte hard disk

Components

• ACS8000-15 (without terminal, printer, or software)	$ 5,990
• ACS8000-6 (without terminal, printer, or software)	$10,490
• Hazeltine 1420 CRT terminal	$ 1,095
• Texas Instruments Model 810 printer	$ 1,895

Storage Device Upgrades for ACS8000-15

• Two single-sided, double-density floppy disk drives	$ 2,000
• Two double-sided, double-density floppy disk drives	$ 3,000
• 14.5 MB hard disk drive (with controller)	$ 4,500
• 29.0 MB hard disk drive (with controller)	$ 5,500
• 10.0 MB hard disk drive (with controller)	$ 4,000
• 10.0 MB hard disk drive (with controller) plus a 13.0 MB magnetic tape cartridge drive	$ 7,500
• 13.0 MB magnetic tape cartridge drive	$ 3,500

Other Options

• Rack Mount	$ 100
• Floating Point Processor	$ 300

OUR OBSERVATIONS

Altos systems are priced without software (the software we used cost $895) and are sold primarily through a distributor/OEM network. Sales and service are handled by the OEM's and/or the larger distributors they buy from.

USER COMMENTS

. *We're pleased with the system ... and the price.*

CENTRAL UNIT .... The Altos ACS8000-15 is a small, portable unit that easily fits on top of a conventional desk. Housed in the main chassis are the dual disk drives, the power supply, and the single circuit board. The system uses the Z-80A processor on a fully socketed circuit board for easy chip replacement. The ACS8000-6 consists of the same system as the "15" plus an additional box (about the same size as the main system) which houses the hard disk drive.

CPU Memory: Both the ACS8000-15 and -6 come with 208 kilobytes of main memory which are partitioned into four user blocks of 48K each (16K is left for the system). Direct Memory Access (DMA) is standard on the systems (this allows the disk controller to access memory without going through the CPU).

Terminal: The ACS8000 can use any standard "dumb" terminal that uses the RS232C interface. This flexibility offers the user a choice from a wide range of terminals on the market.

OUR OBSERVATIONS

The Z-80A microprocessor is a capable chip that is widely used in the industry. As a result of its popularity, there is a large amount of software that can be used on Z-80A based systems.

The ACS8000 uses a single board for its processor, memory, and disk controller. With fully socketed chips, maintenance is easy. The absence of any standard type of data bus (say the S-100) does preclude the use of special purpose boards made by other firms (e.g., graphics boards, voice I/O boards, etc.).

Though the ACS8000-15 and -6 can handle up to four users, we tested the system in a single-user mode (by using the single-user operating system, CP/M). This multi-user capability was often cited for praise by the users we contacted in our survey.

USER COMMENTS

- *The best feature is its multi-user capability.*
- *The speed is not too bad, though I would like to see it run faster.*
- *We wish we had more than 48K in the user partition, but we can program around that.*

ALTOS ACS8000-15 AND ACS8000-6: HARDWARE COMPONENTS

STORAGE

The ACS8000-15 is equipped with dual eight-inch single-sided double-density floppy disk drives. Total storage for the two drives is 1 megabyte. These drives are also available in a double-sided configuration.

Several hard disk upgrade options are available for the ACS8000-15. The system can include an eight-inch 10 megabyte hard disk, a fourteen-inch 14.5 megabyte hard disk (this makes the system an ACS8000-6), or a fourteen-inch 29 megabyte hard disk.

A magnetic tape cartridge subsystem is also available on the ACS8000. It can be purchased as a stand-alone unit or as an integral part of the main chassis. One tape cassette will store 13 megabytes of data (equal to one formatted fourteen-inch hard disk platter).

OUR OBSERVATIONS

The ACS8000 user is presented with a wide variety of storage upgrade possibilities. In total, one ACS8000-15 system can be expanded to two hard disks, one magnetic tape cartridge, and four floppy disks. This would provide the user with 63 megabytes of disk storage and 13 megabytes of tape storage. (The second hard disk drive costs $500 less than the first because they share the disk controller).

Surely it is in this area of disk storage capacities and price that we have seen the most dramatic changes in the microcomputer field. Employing "Winchester-type" technology (sealed unit with "floating" heads), the drives have become more durable, more dependable, smaller in size, and most importantly, less expensive. The eight-inch 10 megabyte drive used by Altos (made by Shugart) fits in the same space as an eight-inch floppy disk drive, holds ten times as much data, performs considerably faster, and only costs about $3,000 more.

The users we surveyed seemed satisfied with their present storage capability and pleased with the possibilities of expanding their capacity when needed. Though we did not have a chance to test the tape cartridge system (one user we spoke to did have it), Altos reports a steadily increasing demand for systems with this feature. We feel this type of backup system is a good buy given the value of a business' database and the cost of alternative systems available on the market.

USER COMMENTS

- *We've had no problems with our disk storage ... and the tape drive is excellent.*
- *We're hoping 29 megabytes will be enough.*
- *Our two floppies just aren't enough. We will have to upgrade to a hard disk.*

OTHER DEVICES

Printers:

- Texas Instruments Model 810
- Many Others

Accessories:

- Rack Mount
- Floating Point Processor
- Prototype Board

OUR OBSERVATIONS

Nearly any printer can be interfaced to the Altos system, but for our tests we used the familiar TI Model 810 printer. A dependable, widely-used printer, the 810 offers programmable forms sizes, variable print densities, and upper/lower case character sets.

To accommodate networking, an RS432 communications port is standard. This port supports 800 kilobits transmission speeds for inter-computer communications.

The users we spoke to had a variety of printers and terminals connected to their system including devices by NEC, Centronics, Texas Instruments, Soroc, and Lear-Siegler.

USER COMMENTS

- *Not a single problem with our NEC printer.*
- *Our Centronics 774 printer is great.*
- *We're not thrilled with our Soroc terminals, but they're okay.*

ALTOS ACS8000-15 AND ACS8000-6: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	CP/M and MP/M (Digital Research), OASIS (Phase One Systems)
Language:	BASIC-80, FORTRAN-80, COBOL-80 (Microsoft), Pascal (Sorcim), APL (Vanguard Systems), and others
Access Methods:	Sequential or random
Utilities:	The CP/M operating system we tested contains the following subsystems:
BDOS -	Basic Disk Operating System
CCP -	Console Command Processor
PIP -	Peripheral Interchange Program
ED -	CP/M Text Editor
ASM -	CP/M Assembler
DDT -	Dynamic Debugging Tool

OUR OBSERVATIONS

The ACS8000-5 system we tested used the CP/M operating system and BASIC-80. All of this software is unbundled (priced separately). As is apparent, there is a wide variety of operating systems/languages available for the Altos system. In fact, Altos publishes a nearly 50 page index of operating systems, languages, and applications packages that can be used on the ACS8000 family of systems.

The ACS8000-15 and -6 do offer multi-user capability and two of the operating systems listed above are multi-user systems (MP/M and OASIS). A number of the users we surveyed did have multiple user configurations and most expressed satisfaction.

USER COMMENTS

- *CP/M has its faults ... but it's the best.*
- *BASIC-80 is real easy to use. We're real happy with it.*

ALTOS SUPPLIED PACKAGES

Though Altos does not offer business applications, there is a large amount of software available to run on the ACS8000 systems. Altos does offer some communications and other software including:

- Floating Point Processor (for Pascal and FORTRAN)
- Word Star (Micro-Pro International) word processing package
- Index Sequential Access Method (Efficient Mgmt. Syst. Co.)
- Altos ASYNC package for asynchronous communications between an ACS8000 system and a remote computer system
- Altos SYNC package (IBM 3780/2780 protocol)
- Altos ALPACA package for inter-Altos communications
- CP/NET networking package (Digital Research)

OUR OBSERVATIONS

The Altos Software Guide lists a number of business application packages available for the ACS8000 systems. The types of packages available include the "Big 5" (Receivables, Payables, General Ledger, Inventory, and Payroll), mail listing, cash disbursements, sort routines, word processing, and a variety of vertical market applications. In addition, there are database management systems and graphics packages available.

The users we talked to were nearly all using their systems for accounting types of applications and a few were doing word processing tasks. In most cases, the user had bought a turnkey system and was not programming the Altos system in-house.

USER COMMENTS

. *The ASYNC package is great. It allows us to use any of the terminals hooked to our Altos as an on-line terminal with the larger system. We can transmit data files back and forth and then use Word Star to print them out. It's really been doing the job for us.*

. *We like Word Star. It's the best.*

EDITOR

Under BASIC-80, the editor is line-oriented with no global change capabilities. Editing is accomplished by typing the command "EDIT" followed by a line number. A series of subcommands are then used to move the cursor, display the lines, and insert, delete, find, and replace text.

OUR OBSERVATIONS

When using the compiled version of BASIC-80, the programmer can use any text editor to create the source code because the compiler does check for syntax errors as it compiles. Alternatively, the programmer may create the source code using the interpretive BASIC-80 and its associated editor (that's what we did). Then the programmer can test and thoroughly debug the program before going through the lengthy compile/link process. We must admit that we think this combination (interpretive create/debug/test followed by compile/link) captures the best of all worlds. It offers the ease of an interpretive environment for programming with the speed and efficiency of compiled code for application execution.

The interpretive BASIC-80 editor we used does not detect syntax errors until program execution, and then finds errors one at a time as encountered, rather than giving a summary list of all syntax errors. This means that a program will execute until a syntax error is found or normal termination occurs.

When a syntax error is found, the line is placed in edit mode with the line number displayed. The programmer can then make the necessary change and re-execute the program. We feel that this approach to editing can be very time consuming for the programmer, especially if a syntax error occurs towards the end of a very long program. We would much prefer line-by-line syntax error checking during program entry, or at least syntax error checking before actual program execution.

Nearly all of the users we contacted in our survey had bought their software from a third party (only two did any in-house programming). For that reason, we have no user comments on the BASIC-80 editor.

DOCUMENTATION

The documentation used by our analyst consisted primarily of the CP/M manual, the BASIC-80 manual, and the Altos ACS8000 User's Manual. In addition, we received other documentation regarding various software utilities and technical hardware information.

MAINTENANCE

Service on the ACS8000 systems is done through Altos' distributor network. Any Altos vendor can offer service on the ACS8000 systems after sending a technician to Altos' maintenance training class. Prices and types of maintenance contracts/coverage are left to the vendor's discretion.

Software support is handled exclusively by the vendors or the systems houses that supply the packages.

TRAINING

Dealers are the primary source of training for the ACS8000 user.

OUR OBSERVATIONS

We are quite familiar with the CP/M and BASIC-80 manuals and have always found them to be very good reference manuals. As has been true of many other system's documentation we've seen, the novice user/programmer would be well advised to seek out more generalized "training-type" manuals and not depend on the reference manuals as learning tools.

Of the users we spoke to, most were satisfied with the service they received from their dealers and nearly all praised the hardware reliability of their Altos system. As is often the case though, comments were varied concerning the documentation from the dealer for their application program(s).

USER COMMENTS

- *I wish there was a good manual for those of us who do not understand "computerese." Then we would not be so dependent on the dealer.*
- *We've had few hardware problems, but when they've occurred, the service from our dealer has been good.*
- *The documentation is so-so. At first, it was more than I could understand, but now, there's not enough information.*

SUMMARY OF USER COMMENTS

Using names supplied by Altos, we contacted ten end-users of the ACS8000 series of microcomputers. These firms included a radio station, three manufacturers, a wholesaler and a textbook firm. Their applications consisted primarily of word-processing and standard accounting.

The firms in our survey had first evaluated systems manufactured by DEC, Wang, IBM, Radio Shack, HP, Data General, Ohio Scientific, North Star, and Alpha Micro. In almost half the cases, users had initially been considering a dedicated word processing unit, but felt the Altos system offered a "general purpose" system rather than a "single purpose" machine. Other reasons for buying the ACS8000 were price, flexibility, hard disk and multi-user capability, and the availability of languages other than BASIC.

An average of three different people in each firm were using their Altos system eight hours a day, five days a week. In most cases, the interviewee had little previous background with computers. To them, the operating system was transparent as they were using "turnkey" packages and simply running their information through the system. Most of the firms had bought "off-the-shelf" packages (four had Word Star and rated it very highly) or other third-party software (only two users were doing some in-house programming).

User hardware configurations varied somewhat with about half using a hard disk (14.5 or 29.0 megabytes) and two floppy disk drives while others had only the dual floppies. One user had the magnetic tape cartridge drive and thought it was excellent. Another user, in addition to employing the ACS8000 as a stand-alone computer, was using Altos' ASYNC package to communicate with a time-share bureau computer.

The users we talked to had from one to four terminals connected to their system and included such brands as Lear-Siegler, ACT, and Soroc. For one person, being limited to a maximum of four terminals was considered a drawback of the ACS8000. Printers being used included NEC, Centronics, and Texas Instruments.

Most users felt they had enough storage, though one user was going to have to add a hard disk. Another user noted that MP/M "divides the hard disk into three sections" and "uses more space than it should." Central memory size was generally regarded as just "adequate," but when a problem with program size did occur, chaining was used to "program around it." The 48K user partition was frequently cited as a limitation.

Hardware reliability for these users was exceptionally good, with only one user reporting "terrible" service from the Altos dealer (this user also reported that software support from that same dealer was very good). Nearly all the other users we surveyed were also receiving good support from their suppliers.

Feelings about documentation for the Altos system were, as usual, quite varied among the users to whom we spoke. One person suggested that if the documentation were more complete, they would be less dependent on the dealer, while others reported not using the documentation at all. Some thought the documentation was "easy to read" and "really pretty good," while others felt that it was "hard to read" and that it "didn't fully explain all the functions inherent in the system."

The ten users we surveyed were all very pleased with their Altos system. They reported dependable hardware and good dealer service. Most were using CP/M and MP/M compatible software "as is" or with minor modifications. Many saw documentation as an area needing improvement, but they were overall, as one user put it, "delighted with the Altos system."

CONCLUSIONS

The Altos ACS8000-15 reviewed in this report uses the popular Z-80A microprocessor and single-board technology. Rather than using separate boards, however, the processor, memory, and disk controller all reside on one board.

The ACS8000 series of computer systems offer a number of disk storage expansion paths using 10, 14.5, or 29.0 megabyte "Winchester-type" hard disk units. A 13 megabyte magnetic tape cartridge backup system can also be purchased. Many of the users we spoke to in our survey were quite pleased with the expansion possibilities of their ACS8000 system and most planned on purchasing more disk capacity as needed. We feel that the tape cartridge backup (at a cost of $3,500) is for many users a sound investment considering the cost of a business' database and the expense of alternative backup systems.

The ACS800 systems are sold by Altos without peripherals and without software ("unbundled"). Though this method leaves the user great flexibility in choosing terminals, printers, and software, it can burden the user with trying to find appropriate, compatible equipment. In most cases though, this problem is solved by the dealer or OEM who puts together a "packaged" system which includes peripherals and software.

The ACS8000-15 comes with enough memory and I/O ports to allow four concurrent users. This report covers the system configured for a single user, and a separate report (ACU's Benchmark Series Vol. 3.2, No. 10) covers the multi-user system. The multi-user capability was often praised by the users we surveyed.

Though Altos itself does not produce software for the ACS8000 systems, there is an enormous amount available from other sources. The prospective ACS8000 user has a choice of several operating systems, a number of different languages (often several different versions of each), communications software, including IBM bisync emulation, and a large variety of applications software. Altos publishes a 45 page Software Guide which outlines the software available and provides the name and address of the vendor that offers it.

In our opinion, Altos offers a dependable, low cost microcomputer system with easy system expansion capability. When combined with any one of a large variety of peripherals and software packages, the ACS8000-15 is a system the prospective business user should consider.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 5, AUGUST 1981

In This Issue:

The NEC Astra 205

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., an affiliate of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

NEC ASTRA 205: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: Astra 205	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

This is our third report in the Continuation of Series 1 and 2 Benchmark Reports and covers the NEC Astra 205. This series evaluates systems designed principally for single-users and costing under $25,000.

Many of our readers are buying their first computer, while others have had more experience in the computer field. Systems they have considered range from the "personal computer" to large multi-user systems, and configurations range from assembling multi-vendor components to integrated single-vendor turnkey products. The range of choices is wide and rapidly growing.

These reports are valuable to experienced and inexperienced users alike by providing an assessment of some of the microcomputer systems available today. Our test results are comparable across computer systems and provide a basis for evaluating the vendors' hardware. Our observations of the systems in a "real world" setting, and our comments about software, can help potential users intelligently select a system that is best for them. There is no single "best" system. While we present price/performance information, performance is a multi-faceted concept which can only be evaluated in terms of user requirements. We can only tell you what the systems will do, not what they should be capable of doing in your business.

The heart of these reports is the comparative results of running five benchmark programs on each system under study. These programs are designed to test capabilities needed by users in an operating environment. The results of these benchmark runs provide comparative information which is simply unavailable from any other source. Also contained within these reports is information on alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, and the availability of application packages. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report.

Our benchmark reports continue to be a significant resource for understanding differences among systems, their capabilities, maximum configurations, and the manufacturer's support and philosophy.

EXECUTIVE SUMMARY

Priced at $11,950, the Astra 205 offers a number of features not ordinarily found in a small system. The hardware consists of the central unit mounted in the CRT, a 16-bit microprocessor, 128 kilobytes of memory, a detached keyboard, and dual 1.2 megabyte disk drives. The software consists of the operating system (Astra/OS) and many utilities.

- The Astra 205 system we tested is based on a compiled Business BASIC which is similar in structure to COBOL. It is screen-oriented and includes features for controlling the cursor, editing of input fields, underlining, etc.

- The Astra 205 is a relatively new product, and NEC was only able to provide us with two user names (along with four OEM's). As always, user satisfaction depends upon the service provided by local dealers.

- NEC provides an extensive line of application software, and OEM's provide custom programming. Software created on the Astra 205 will also run on other Astra systems. Thus, a growth path is built into the series without having to redesign the software as computer operations grow.

- The Astra 205 is an integrated system. In addition to the screen oriented features of the BASIC language, there are 27 function keys on the keyboard. They include editing keys (insert, delete, etc.), system control keys (log-on, interrupt processing, detach job, etc.), and user programmable keys.

- The Astra 205 uses the same operating system as the multi-user versions of the Astra series. As such, there are probably more features available than the average single-user installation can use.

- Program development--the edit, compile, link, execute series--is time consuming. However, the features of BASIC which simplify writing screen-oriented applications help to offset this disadvantage.

- Application documentation is well done, with illustrations of how to use the package. System and programming documentation, while extensive, is not always easy to use since most manuals do not have indexes. Also, they tend to assume a great deal of knowledge of computer architecture and operations.

Overall, we had mixed reactions as we used the Astra 205. The extended BASIC, while different from most we have used, had some very nice features. The operating system, while more complicated than required, also possessed some useful features. However, these complexities mean that the end-user can expect to have well designed screen-oriented applications.

BENCHMARK REPORT

SYSTEM: NEC Astra 205

PRICE AS TESTED: $11,950

SPEED TESTS

Benchmark Number	*CPU INTENSIVE*	TOTAL TIME* Min.	Sec.
A-1	N = 500		**
A-2	N = 1000		**
A-3	N = 2000		**
A-4	N = 3000		**
A-5	N = 500	5	18.7
A-6	N = 1000	5	53.3
A-7	N = 2000	7	2.5
A-8	N = 3000	8	11.8
	I/O INTENSIVE		
B-1	N = 500	6	59.8
B-2	N = 1000	7	12.5
B-3	N = 2000	7	24.8
B-4	N = 3000	7	45.9

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME* Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	20	18.8
C-1A		10	53.9
C-2	NEW PRODUCT PLANNING	8	32.3
C-2A		8	12.1
C-3	ACCOUNTS RECEIVABLE	26	26.4
C-3A		27	57.4

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	125
E-2	SUBJECTIVE JUDGMENT	Very Easy

* The times reported here include compile plus run times. "Run Only" times are reported in the Overview of Programs and Results.

** The Astra 205 does not have exponentiation or square root functions.

THE BENCHMARK PROCESS

The benchmark programs were run on the NEC Astra Model 205 system, consisting of a 16-bit processor, 128 kilobytes of memory, dual 1.2 megabyte floppy disk drives (a total of 2.4 megabytes of on-line storage), CRT, keyboard, and a 120 character-per-second dot matrix printer. In this single user version of the Astra line of computers, the central processor, memory, and controller boards are contained in the CRT unit. The keyboard, disk drives, and printer are detached units connected to the central unit via cables. The system will support an additional 128 kilobytes of memory (for a total of 256K), and two drives can be added (for a total of 4 drives with 4.8 megabytes of on-line storage). A 55 character-per-second NEC Spinwriter letter quality printer can be substituted for the dot matrix printer.

The unit was delivered to our offices in Boulder, Colorado, where we assembled the components. NEC also provided their usual installation and testing service through their Denver based agent. After correcting a power supply problem in the disk drive, the system was operational and we proceeded with the benchmark process. A NEC representative spent two days with us, familiarizing us with the system, providing support for conversion of the benchmark programs to NEC's version of BASIC, and demonstrating features of the system.

During the benchmark process our emotions ranged from frustration, to understanding, to amazement. The frustration, as programmers, came because we were dealing with an integrated hardware/software "package" unlike any with which we have previously dealt. For example, the keyboard contains 27 special function keys which control the system and applications and this took some getting used to. Also, the BASIC was very COBOL-like in its structure, so program conversion was more difficult than anticipated.

However, after a few days with the system, we became comfortable with its use and understood most of the common features and requirements. The system was designed to ease program development by OEM's, and many features are provided to simplify form-fillout applications, data entry, and file maintenance.

Finally, after reviewing the manuals in much more detail, we have found ourselves intrigued by the features "packed" into this small system. System

access can be controlled through user identification; error message files can be created; a sort/report generator is included; and an attach/detach mode is available for running several jobs simultaneously from a single workstation.

Documentation used during the benchmark process consisted of the BASIC Programmer's Guide, Program Development Facilities, and the Utilities User's Guide. In addition, we reviewed the Technical Information manual, the System Generation Guide, and the Operator's Guide. Documentation was complete, and contained examples and illustrations of key concepts. However, only two of the manuals contained an index; the others were difficult to use as reference manuals.

Some of the features of the NEC Operating System and BASIC are:

- Software compatibility through the Astra line, up to the 16-user Model 250. The operating systems provide identical functions, and application software does not need to be rewritten.
- A COBOL-like data definition section is required in BASIC. Variables and data records must be explicitly defined. However, data areas can have multiple definitions, and a single name used to refer to a group of variables. Also, input format characteristics can be specified to indicate required data, type of data, etc.
- A number of screen and printer control characters are available to position output, draw boxes, set character intensity, underline, etc.
- A compiled BASIC which requires the often time consuming edit, compile, link, and execute sequence.
- The operating system provides features usually found only on larger systems, including user accounting, simplified creation of menu-driven applications, multi-tasking (running two programs at a single user workstation), and a number of system and data file maintenance utilities.

After converting our benchmark programs to NEC's version of BASIC (a time consuming process), the programs were entered, debugged, and stored on diskette. The compiled versions were then run with output to the screen (and to the printer for report programs).

OVERVIEW OF PROGRAMS AND RESULTS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that use repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

			With Compile	Run Only
A-1	Results:	N = 500	--	--
A-2		N = 1000	--	--
A-3		N = 2000	--	--
A-4		N = 3000	--	--

Comment: The Astra 205 does not have exponentiation or square root functions.

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

			With Compile	Run Only
A-5	Results:	N = 500	5:18.7	35.1
A-6		N = 1000	5:53.3	1:09.7
A-7		N = 2000	7:02.5	2:18.9
A-8		N = 3000	8:11.8	3:28.1

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disk and then retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

			With Compile	Run Only
B-1	Results:	N = 500	6:59.8	2:29.0
B-2		N = 1000	7:12.5	2:41.7
B-3		N = 2000	7:24.8	2:54.0
B-4		N = 3000	7:45.9	3:15.1

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$

$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$

$$\vdots \qquad \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

		With Compile	Run Only
C-1	Results:	20:18.8	14:27.9

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

		With Compile	Run Only
C-1A	Results:	10:53.9	5:03.0

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Distribution
- Gross Profits
- Fixed Costs
- Net Before taxes

- Direct Labor
- Packaging
- Taxes Payable
- Net Income

C-2

	With Compile	Run Only
Results:	8:32.3	36.8

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C-2A

	With Compile	Run Only
Results:	8:12.1	56.1

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C-3

	With Compile	Run Only
Results:	26:26.4	5:10.8

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C-3A

	With Compile	Run Only
Results:	27:57.4	5:57.4

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string.

E-1

Results: Approximately 125 keystrokes were required to edit the nine-line test file.

Comment: These results are not comparable with others reported in this series since we used a separate screen-oriented editor rather than an interactive BASIC line-oriented editor.

NEC ASTRA 205: PRICING COMPONENTS

COST

Astra 205, as tested $11,950

Includes:
- CRT
- 16-bit word length processor
- 128 kilobytes of memory
- Detached keyboard
- Dual 1.2 megabyte floppy drives
- 120 cps dot matrix printer

Components:

- Astra 205 (without printer) ..... $ 8,560
- Printers

  55 cps NEC Spinwriter ..... $ 3,390

  120 cps dot matrix ..... $ 3,390

- Expansion

  Single 1.2 megabyte drive (inclues power supply, chassis)... $ 2,800

  Second expansion 1.2 megabyte drive ..... $ 1,400

  64 kilobytes of memory ..... $ 1,800

  Communications interface ..... $ 800

OUR OBSERVATIONS

The system is marketed through OEM's who sell NEC packages as well as provide custom programming. NEC provides an extensive line of applications. The system can be complex to program, but, from an end-user viewpoint, can be very simple to operate.

USER COMMENTS

- *Overall, it's simple to use, reliable, offers a lot of capability with the software. The drawback is from a hardware standpoint--it's not expandable and the operating system might be more than a user needs. From our standpoint, it's a good machine. For a new user with single-task accounting it's great.*

- *It's a real good unit. Best feature is that a small business can use it without hiring a programmer. Knowing bookkeeping is more important. I'd like to see a small hard disk.*

NEC ASTRA 205: HARDWARE COMPONENTS

CENTRAL UNIT	The Astra 205 system is mounted as an integral part of the CRT unit. Lifting the cover exposes all components (CPU, disk controller board, memory, etc.). On the Astra 210 and above, the central processor is separate from the CRT, so a simple hardware upgrade is not possible (although software runs on all models of the Astra).
CPU Memory:	The Astra 205 comes with 128 kilobytes of memory, and can be expanded to 256 kilobytes.
CRT/Keyboard:	The CRT displays green letters on a black background, and has reverse video, blinking, underlining, cursor positioning, and other features. The detached keyboard contains 27 function keys, some of which are programmable, an eleven-key numeric pad, and a standard alphanumeric keyboard layout.
Processor:	The Astra series is based on a 16-bit microprocessor.

OUR OBSERVATIONS

This is an integrated system, where the programmable features of the CRT and printer, and the function keys of the keyboard, are combined with BASIC and the operating system to provide features not found on many small systems.

The programmable CRT includes selective scrolling of portions of the screen, reverse video, high and low intensity, blinking, underlining, etc. These "attributes" are controlled with simple BASIC commands.

The system function keys are used to control system operations, and include Interrupt (for suspending operations so a temporary task can be performed such as making a quick file inquiry), Detach/Attach (where multiple tasks can be simultaneously running in a background/foreground mode), Explain (where a user can ask for additional explanation of a command or input), Log On/Off, etc.

Program function keys are used by application programs and utilities, so their use depends upon the application. A card and slot under the function keys can be used to label their intended use, and the application programs issued by NEC include a pre-printed card.

USER COMMENTS

- *128K is plenty. Internal processing speed is fine. I'd like to see a cartridge disk added. Best feature is flexibility of application programs. Hardware is excellent.*
- *128K bytes is more than enough and it's as fast as I need.*
- *It's doing all my jobs all right. I'm not taxing it though.*

NEC ASTRA 205: HARDWARE COMPONENTS

STORAGE

The Astra 205 comes with dual double sided/double density 8-inch drives giving a total of 2.4 megabytes of on-line storage. However, a good portion of one drive is consumed by the operating system, utilities, working storage, and programs, leaving the other drive for data files.

The system can be expanded to 4 drives total, where the cabinet and power supply for expansion can be purchased for $1,400, and each drive costs $1,400 (the total cost of two additional drives would be $4,200).

OUR OBSERVATIONS

The Astra 205 does not have any hard disk capability, which we feel is an unfortunate omission. However, the 1.2 megabytes available on a single diskette should be sufficient for many businesses. Additionally, the 205 supports multi-volume files, so the 1.2 megabytes is not a major restriction.

File space must be allocated prior to use, since the Astra 205 does not have dynamic file allocation. The user must go through a series of simple formulas to determine how large program and data files might be, and set aside space on the disks for those files.

USER COMMENTS

- *2.4 megabytes is limited for my applications--my mailing list is too large.*
- *Data storage is fine, although you can't have all the programs up at one time as you could with a hard disk.*
- *2.4 megabytes for most applications is okay, but for multi-tasking you would need more.*

OTHER DEVICES

Printers:

55 character-per-second NEC Spinwriter
120 character-per-second dot matrix printer

Board Accessories:

Communications interface
Additional memory

OUR OBSERVATIONS

For the benchmarks, we used the 120 character-per-second dot matrix printer, which produced excellent readable copy. NEC has an excellent reputation for producing quality printers, particularly the Spinwriter.

The communications interface provides synchronous and asynchronous capabilities. In the synchronous mode, it can provide 3780/3740 protocol, and also Astra-to-Astra batch file transfer.

In conjunction with the Word Processing package from NEC, the letter quality Spinwriter would be a good investment. It is always cost effective to combine functions like data processing and word processing, particularly since many businesses do not have workloads sufficient to keep separate systems busy.

USER COMMENTS

- *Keyboard and screen are comparable to a $25,000 system. They're very good. CRT is easy to read. 120 cps printer is as good for the dollar as any on the market.*
- *I like the printer fine. That's a beautiful piece of equipment.*

NEC ASTRA 205: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	Astra/OS Version 3.5 (as tested)
Languages:	Business BASIC (as tested), COBOL, and Assembly
Utilities:	Astra/OS contains system management utilities, file management utilities, and program development utilities.

OUR OBSERVATIONS

The operating system takes 102K of main memory, leaving 26K available for the user in the minimum configuration. BASIC is compiled, and the compiler itself takes 24K of memory. The compiler appears to make extensive use of the disk for intermediate storage, and the compilation process was long (compare the with and without compile times), even for short programs.

The system management utilities include a system generation procedure, an accounting system for controlling user access to files and programs, a menu generator for prompting users, and a message file utility for customizing system and program error messages. File management utilities include media management for allocating files, listing directories, and copying files and disks, as well as sort and merge utilities for accessing specific files. Program development utilities include the text editor, the linker, and a screen format generator which can be used to layout screens which are then linked to a BASIC program.

BASIC is very COBOL-like because there is a required Data Division in which all variables and data records must be pre-defined. While there are certain benefits to be gained with this, there are also disadvantages, though it certainly does force a more cautious approach to programming. The CRT screen is easily controlled from a BASIC program, including selective scroll areas, underlining, placing prompts in boxes, and edit checking of input fields.

SPOOLING (Simultaneous Peripheral Operations On-Line) is available. This can greatly increase throughput since the user does not have to sit waiting for the printer to finish one report before beginning another task.

USER COMMENTS

- *Super software and very comprehensive. In some cases it might be more software than a floppy system can use. Its got many bells and whistles.*

NEC SUPPLIED PACKAGES

NEC supplies the following packages

- Accounts Payable
- Accounts Receivable
- Billing Control
- General Ledger
- Inventory Control
- Payroll
- Sales Analysis
- Astra WRITE (Word Processing)
- NEC SMART

OUR OBSERVATIONS

The business applications are fully integrated to provide automated record keeping for the small business.

We looked at the Accounts Receivable system, and were impressed. It was well thought out, and made extensive use of menus, form fill-out, automatic fill-in of fields, error checking, and other features of the powerful screen-oriented BASIC. Obviously, a great deal of care has been taken by NEC to create error free, easy to use packages. The Operator's Information manual which accompanies the system was clear and complete, covering all aspects of using the package.

NEC SMART is a utility program which can create, update, and retrieve records, and generate reports. Combined with the screen generator, SMART can be viewed as a "parameterized" language where extensive applications can be written by simply defining records, screens, and report formats in response to prompts from SMART. Once a user has learned how to use SMART, business applications can be written in as little as one-tenth the time required by BASIC or COBOL.

USER COMMENTS

- *Astra Write System is nice, though it's not a full-blown word processor. General ledger, payables, and payroll are a little weaker, though inventory control is a very, very strong package. Text editor is as nice as anything I've seen.*

- *Software is equal to packages for larger systems.*

NEC ASTRA 205: SOFTWARE COMPONENTS

EDITOR

Because it is a compiled BASIC, the editor is a separate module. Thus, we cannot directly compare this editor with others which are contained as an integral part of an interpretive BASIC.

OUR OBSERVATIONS

The editor is screen-oriented, so many changes can be made on a screen full of information simply by moving the cursor around and over-typing the errors. This is handled through the modification mode of the editor.

In the insert mode, individual lines of text can be added. In the command mode, global searches and replacements can be made, text saved or recalled in files, blocks of text moved, etc.

The editor makes extensive use of the programmable function keys to control scrolling, move the cursor, delete and insert characters, etc.

USER COMMENTS

- *Text Editor is good.*
- *Text Editor is not full-blown, but it works fine.*

DOCUMENTATION

There is extensive documentation on the Astra system. For the Astra 205, there is a Business BASIC notebook which contains examples of how to use the system, as well as the three principal manuals needed to operate this single-user system: Program Development Facilities, Utilities User's Guide, and BASIC Programmer's Guide.

In addition, there are operating system guides, equipment guides, and application manuals which cover various aspects of hardware and software. The operating system guides would be useful for the larger multi-user systems in the Astra line.

Our reaction to the documentation was mixed. While it is generally complete in coverage, it is not well indexed, making it difficult to use for reference. Additionally, the terminology used--load modules, work files, file members, initial program load--is not particularly common in the microcomputer field, so we sometimes had problems relating the written material to our own knowledge base.

MAINTENANCE

Maintenance contracts are available from NEC, and the service is performed by NEC personnel or by authorized independent service dealers.

TRAINING

Training is provided by OEM's who sell the systems and install applications.

USER COMMENTS

- *Very prompt hardware service. Could be better software support though they're doing an adequate job now. Documentation leaves a little to be desired--it's not good for making modifications. Training was very good.*
- *There is plenty of documentation, though it's difficult for me. I had to go through 400 pages before I felt I could go ahead.*
- *Documentation is very concise, step-by-step. Best documentation I've seen. It's geared to the user.*

SUMMARY OF USER COMMENTS

Using names supplied by NEC Information Systems, we were only able to survey six people about the Astra 205. Of these, four turned out to be dealers for NEC and only two were end-users in legal and business services. These two owned their 205's for three and ten months and were using it one or two hours a day, five days a week. One or two personnel in each office used the system for mailing lists and general accounting.

Before buying the Astra 205, these two users had evaluated other systems including DG, HP, and personal computers. They both gave software and the reliability of the dealer as their primary reasons for choosing NEC.

Their hardware configurations were similar with 128K bytes central memory and the standard 205 terminal. However, one user had 2.4M bytes storage and the other had 3.6M bytes. Both had NEC printers and one was using the 55 cps letter quality printer, but the other didn't know which model he had.

All of those interviewed, including the dealers, felt the hardware was reliable. One of the users did have startup problems, but these have since been solved. He said nobody was sure if they were hardware or software problems but the dealer's service was "very prompt."

Data storage capacity was adequate for the user with 3.6M bytes but 2.4M bytes was limiting for the other user's applications. Dealers noted that a user would need more storage for multi-tasking applications. All six people agreed that 128K bytes central memory was "more than enough." One dealer said it is "enough for one user if you don't use multi-tasking too often."

NEC's printers were viewed as one of the most outstanding components of the system. The users liked the extra features such as the alert signals, and one user said, "it's a beautiful piece of equipment." The keyboard and screen were also well liked. One user, however, felt that the keyboard offered more than he could take advantage of, including function keys he didn't use.

Users and dealers alike said the 205's speed was very good. The dealers said the operating system was effective, sophisticated and flexible, though one

dealer noted that the floppy based 205 really couldn't take advantage of the operating system in all cases. One of the users said that it was difficult to do a system generation because he needed the operating system disk in to get messages but yet he also needed the space it took up.

Neither of the two users were doing in-house programming. One user's applications were in BASIC but the other wasn't sure what his programs were written in. Dealers made a variety of comments about the Astra's languages. They said, "programmers love SMART," "COBOL is excellent," and "BASIC looks a lot like COBOL and it is very powerful."

The two users bought the Astra 205 mainly because of the NEC software that was available and applicable to their business, and, overall, they were satisfied with its performance and the dealer support they received. Dealers were also generally pleased with the software they sold. Dealers said the software was comprehensive, but that some packages were stronger than others. The ACS package (general ledger, payables, payroll) needed more field testing, according to one dealer.

Comments about documentation, training and manufacturer support were varied. From the users' viewpoint the documentation was felt to be lacking. Dealers' judgment about the documentation covered a range from marginal and preliminary to very concise and the "best documentation I've seen." Only one user received training and said that the help he received was good. Two dealers said NEC could use more people to provide field support and a user saw a need for better communication between the dealer and NEC.

The two users we talked to were basically pleased with their Astra 205. One user was limited by storage capacity and the other was only slightly inconvenienced by the way his general ledger package formatted output. The dealers, of course, were very enthusiastic about the 205. They said it is great for a small business with single-task accounting and that the hardware is excellent, but not being able to add terminals or a hard disk were among its limitations.

CONCLUSIONS

Evaluating the Astra 205 has been difficult. The uniqueness of the system (the structure of BASIC and nomenclature used in the manuals) and resource management requirements (preallocation of files, and the Data Division in BASIC) are the things we disliked most. Uniqueness is bad only in the sense that it can make a system more difficult to deal with and/or lock the user into a particular vendor. Also, we don't feel the user should have to manage system or program resources.

On the other hand, the integrated approach yields some very nice features. The easy control of the screen from BASIC simplifies writing interactive applications. Also, the many system and programmable functions on the keyboard provide a great deal of versatility. Finally, the ability to run multiple tasks from a single terminal (including spooling of output) greatly extends the usefulness of this single-user system.

The two users we interviewed were happy with their systems, and had purchased them because the software available met their needs; the only possible limiting factor was disk storage space. OEM's were very happy with the system, but agreed that the operating system provides more features than required for a single-user system, while the flexibility is there for those who need it.

One particularly nice software feature is NEC SMART, a data management system which can sort, update, retrieve, and generate reports based on a set of parameters provided by the user. In combination with the screen generator utility, entire applications can be written in SMART.

Overall, we were impressed with the NEC as an end-user oriented system, with features which simplify the programming and use of applications. However, because of the small number of end-users interviewed, we would recommend that the potential buyer contact other users in their local area--in order to evaluate local dealer support--before making a final decision.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

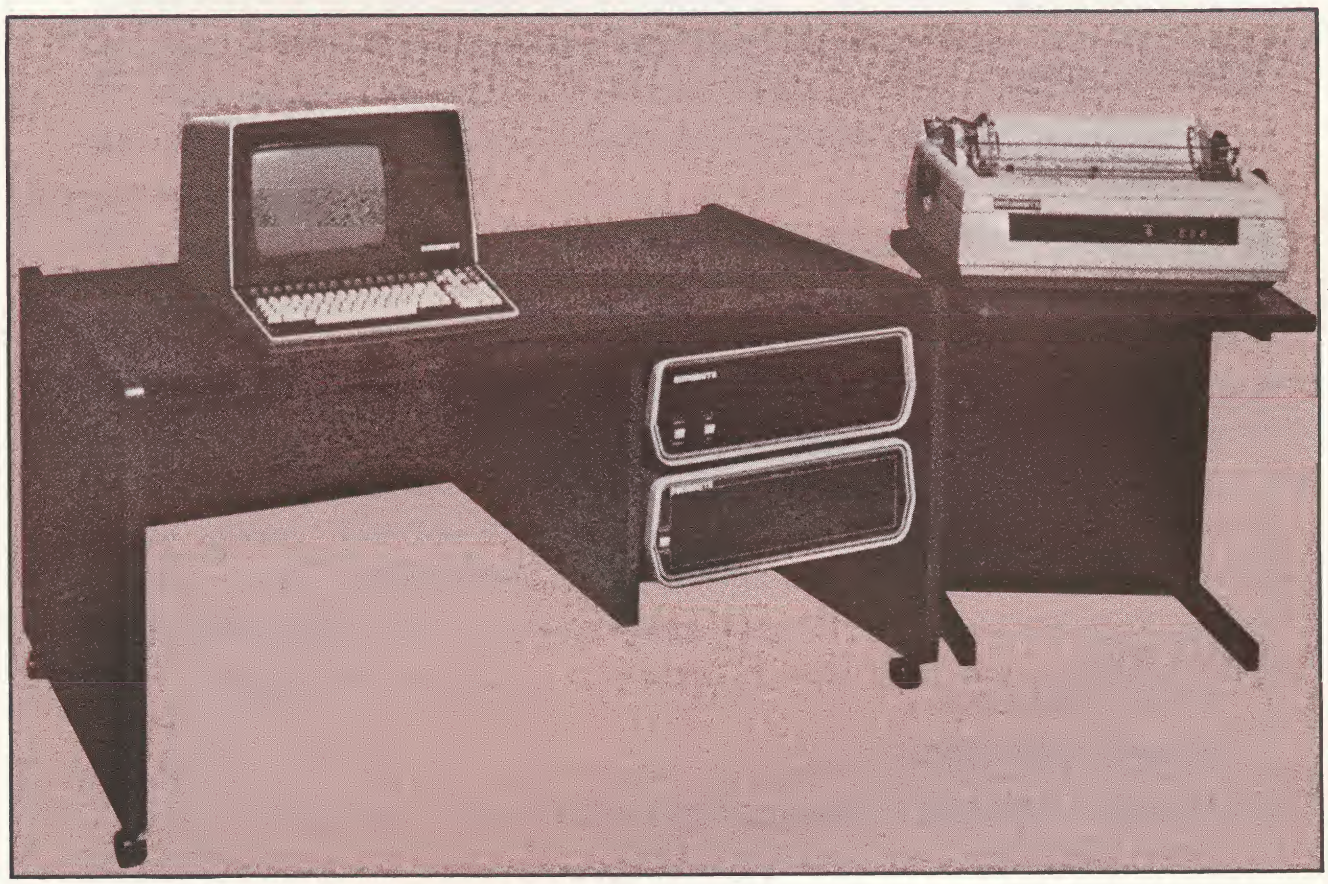
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 6, NOVEMBER 1981



In This Issue:

The DYNABYTE 5300

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

DYNABYTE 5300: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: Dynabyte 5300	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

The Dynabyte 5000 Series computer is the sixth system to be evaluated in our continuation of Series 1 and 2 benchmark studies. While this series covers mainly single-user systems costing under $25,000 we are increasingly finding systems in this price range that have multi-user capabilities. The Dynabyte 5300/A2 system is priced at $8,535 and the Dynabyte 5600/C1 with hard disk capabilities is priced at $16,635.

The benchmark programs used in preparing these reports represent capabilities needed by users in an operating environment. The results of running these programs on each of the systems under study forms the heart of these reports, and they provide comparative information which is simply unavailable from any other independent source. Since the programs have been designed to run without change on most small computer systems, differences in performance among systems can be attributed to differences in computing capabilities.

In addition to the benchmark results, these reports contain information on the alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on the ease of use of the system. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report. The experiences of users add a dimension of reality to the technical details of the system.

Information provided by manufacturers can often be difficult to interpret and sometimes misleading. While some of the potential buyers of microcomputers have some background with computers, the majority we've surveyed are buying their first computer, and often the personnel using it will not have had much direct experience with computers. We feel these reports are invaluable to experienced and inexperienced users alike by providing an unbiased asessment of some of the microcomputer systems on the market today. Our results, which are comparable across computer systems, and our observations of the system in a "real world" setting can help potential users intelligently select a system that is best for them.

EXECUTIVE SUMMARY

The Dynabyte 5300, priced at $8,535 as tested, consists of an intelligent terminal with keyboard, the central processor with 64 kilobytes of memory and a Z-80A processor, dual 8-inch floppy disk drives, and an Epson MX80 printer. The Dynabyte 5000 series offers expansion up to eight simultaneous users, and up to 96 megabytes of hard disk storage.

- Dynabyte's DOS is an enhanced version of the CP/M operating system from Digital Research. It includes a system configuration utility that greatly simplifies setting up the system and/or adding components at a later time. With the CP/M operating system, the user has available a wide variety of software--application packages, utilities, and languages--which have been developed over the years.

- The processor, the floppy disk drives, and the Winchester hard disk are each contained in matching cabinets which may be stacked on a table or placed into a disk unit which is sold by Dynabyte.

- With the Octaport board (eight input/output ports), and the MP/M operating system, the Dynabyte will support up to eight simultaneous users. This is an important capability which we are seeing more of among the smaller microcomputer systems. They will noticeably slow down as users are added to the system, but still provide sufficient computing capacity for many small business applications.

- A feature we particularly liked about the single-user system we tested was the ability to put up to four terminals and four printers on the system. Though only one printer and one terminal can be used at a time (it was, after all, a single-user system), it does allow terminals and printers to be distributed in a building so that users can have access from local work areas.

- Users were generally pleased with their Dynabyte system. The principal area of dissatisfaction was with application software. Those who had spent some time developing specific applications were pleased. Those who had purchased off-the-shelf applications were mixed in their feelings. While some were, as expected, outgrowing the capacity of the Dynabyte and were considering larger systems, they were all generally pleased with the performance and reliability of the hardware. Also, users generally had good relations with and support from their dealers.

Overall, the Dynabyte 5000 series provides a capable system at a relatively low price. Its most attractive feature is the expandability through Dynabyte manufactured hardware and software (which we prefer to the mix-and-match approach of designing your own system). Expansion is eased by using Dynabyte's own system configuration utility, DYNASYS. With multi-user capabilities, it looks like a good buy.

BENCHMARK REPORT

SYSTEM: DYNABYTE 5300

PRICE AS TESTED: $8,535

SPEED TESTS

Benchmark Number		TOTAL TIME* Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500	2	15.3
A-2	N = 1000	2	35.7
A-3	N = 2000	3	16.6
A-4	N = 3000	3	57.2
A-5	N = 500	1	54.6
A-6	N = 1000	1	57.3
A-7	N = 2000	2	2.0
A-8	N = 3000	2	6.6
	I/O INTENSIVE		
B-1	N = 500	2	40.9
B-2	N = 1000	2	48.5
B-3	N = 2000	2	57.0
B-4	N = 3000	2	67.2

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	7	43.7
C-1A		4	8.0
C-2	NEW PRODUCT PLANNING	2	22.2
C-2A		3	51.0
C-3	ACCOUNTS RECEIVABLE	11	1.5
C-3A		13	59.3

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	208
E-2	SUBJECTIVE JUDGMENT	Easy

* The times reported here include compile plus run times. "Run Only" times are reported in the Overview of Programs and Results.

THE BENCHMARK PROCESS

The benchmark programs were run using Microsoft's compiled BASIC-80 under Dynabyte's DOS, an extended version of the popular CP/M operating system from Digital Research. The Model 5300/A2 we tested consists of two desk-top units, one containing the main computer, and one containing dual 8-inch floppy disk drives. With the addition of a hard disk in a third unit, the system becomes a Model 5600/C1. A separate Dynabyte smart terminal with CRT and keyboard, and a printer completes the system configuration.

The Dynabyte 5000 series is based on the Z-80A microcomputer chip and the S-100 internal bus. The disk drives are single-sided and each disk will hold one-half megabyte, for a total on-line capacity of 1 megabyte. The system we used contained 64 kilobytes of main memory.

The unit was shipped to our office in Boulder, Colorado. Interconnecting the three units (main computer, floppy disk, and hard disk) required removing the tops and connecting cables, a procedure that is common in component-based systems. Our only problem was in one illustration which indicated an incorrect connection, though the written description was correct. When properly connected, the system operated without fault during our benchmark process.

Documentation was in three parts: the CP/M manuals, the BASIC manual, and Dynabyte's hardware/software documents. The CP/M manual is quite variable in its level of presentation and readability, though the various sections of the manual are designed for different readers. Sections covering user interface and utilities (the editor, file manipulation, etc.) are reasonably well done. Sections covering system generation, modification, etc., require a detailed knowledge of the particular computer system and a general knowledge of operating system software before they make much sense.

Microsoft's BASIC manual is generally good, though it is designed as a reference manual and not as a BASIC teaching manual. Each instruction and/or command is explained and an example is shown. The manual also contains sections on using the interactive and compiled versions, along with supporting utility programs. The real benefit of this version of BASIC is that it comes in an interactive version as well as the compiled version we used for testing.

Dynabyte's documentation consists mainly of technical hardware manuals on the three units: main computer, floppy storage, and hard disk storage. The DOS (disk operating system) manual discusses the extensions Dynabyte has made to the CP/M operating system. Particularly useful is DYNASYS, a program which aids initial configuration of a system. This is a menu-driven program where the user describes the hardware characteristics and the program automatically modifies CP/M. Having spent many hours reading CP/M and hardware manuals, trying to figure out how to initialize other systems, we appreciated the ease with which it can be done on the Dynabyte.

We used the CP/M editor to enter the programs. Because BASIC-80 is a standard version of BASIC, virtually no modifications were made to our programs. After the programs were entered, we ran the compiler for syntax checking, and the linker to create executable program modules.

BASIC-80, Version 5.2, from Microsoft was used for our testing. Some of the features of this version of BASIC are:

- Error trapping capabilities. This means that on program errors, the user can maintain control within the program and correct errors without aborting.
- Structured programming features such as IF . . . THEN . . . ELSE, WHILE . . . WEND.
- Mathematical functions, string manipulation, user defined functions, etc., which simplify programming.
- Sequential and random record input/output.

All programs were run with output to the CRT screen. For those programs having printed output, we changed all PRINT statements to LPRINT which directed output to the printer. The programs were entered, edited, and stored on disk. To execute, they were loaded into memory, the RUN statement typed in, and the stopwatch started when the carriage return was pressed. Timing was stopped when output was complete and/or the program terminated normally.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease Of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

			With Compile	Run Only
A - 1	Results:	N = 500	2:15.3	20.7
A - 2		N = 1000	2:35.7	41.0
A - 3		N = 2000	3:16.6	1:21.9
A - 4		N = 3000	3:57.2	2:02.5

Comment: The hard disk times with compile were 1:30.1, 1:50.5, 2:31.3, and 3:12.0, respectively. Since this program does not use the disk, run only times were the same.

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

			With Compile	Run Only
A - 5	Results:	N = 500	1:54.6	2.6
A - 6		N = 1000	1:57.3	5.0
A - 7		N = 2000	2: 2.0	9.8
A - 8		N = 3000	2: 6.6	14.3

Comment: The hard disk times with compile were 1:11.3, 1:13.6, 1:18.4, and 1:23.0, respectively. Since this program does not use the disk, run only times were the same.

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disks and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

			With Compile	Run Only
B - 1	Results:	N = 500	2:40.9	43.8
B - 2		N = 1000	2:48.5	51.4
B - 3		N = 2000	2:57.0	59.9
B - 4		N = 3000	2:67.2	1:10.1

Comment: The hard disk times with compile were 1:26.9, 1:30.8, 1:37.6, and 1:44.7, respectively. Run only times were 13.6, 17.5, 24.3, and 31.5, respectively.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$
$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$
$$\vdots$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

		With Compile	Run Only
C - 1	Results:	7:43.7	5:39.5

Comment: The hard disk time with compile was 6:57.3, and the run only time was the same.

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

		With Compile	Run Only
C - 1A	Results:	4: 8.0	2: 3.7

Comment: The hard disk time with compile was 3:21.6, and the run only time was the same.

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is

established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

		With Compile	Run Only
C - 2	Results:	2:22.2	8.3

Comment: The hard disk time with compile was 1.32.1, and the run only time was the same.

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

		With Compile	Run Only
C - 2A	Results:	3:51.0	1:36.9

Comment: The hard disk time with compile was 3:0.8 and the run only time was the same.

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

		With Compile	Run Only
C - 3	Results:	11: 1.5	4:38.0

Comment: The hard disk time with compile was 5:42.0, and the run only time was 1:36.3.

Variation: C-3 Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

		With Compile	Run Only
C - 3A	Results:	13:59.3	7:35.9

Comment: The hard disk time with compile was 8:42.3, and the run only time was 4:36.6.

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1	Results: Approximately 208 keystrokes were required to edit the nine-line test file.

DYNABYTE 5300: PRICING COMPONENTS

COSTS

Dynabyte Model 5300/A2 (as tested)..... $ 8,535
Dynabyte Model 5600/C1 (with hard disk) $16,635

Model 5300 includes:

- Model 5022 Smart Terminal (CRT and keyboard)
- Z-80A Central Processor
- 64 kilobytes of central memory
- Dual 8-inch floppy disk drives
- Epson MX80
- Microsoft BASIC-80 (compiled)
- Dynabyte DOS (CP/M 2.2 based)

Model 5600 includes:

- All of the above
- 23 megabyte (unformatted) hard disk

Components

● 5100 central processor with 64k of memory	$ 3,395
● CRT terminal	1,895
● Dual 8-inch single-sided floppy disk drives	3,395
● Epson MX80 printer	645
● 23 megabyte hard disk	8,795
● DOS (disk operating system)	N/C
● Microsoft compiled BASIC	500

OUR OBSERVATIONS

The Dynabyte did not come with a printer, and each dealer would supply their favorite. A local Dynabyte dealer supplied an Epson MX80 which we used for the benchmark runs where printer output was required.

The Dynabyte is marketed through a dealer network. Service and training is provided by the local dealer.

USER COMMENTS

- *64K is enough. No problem with speed. The system has been fine. There are no problems with it.*
- *Speed is poor a lot of the time when more terminals are added (two CRT's total). I'm very impressed with it. Speed is the only problem.*
- *It's very fast. No degradation when all five terminals are running. We've only had it two months and it would be unfair to judge it. Its advantage is that it's a multi-user system. No drawbacks for our use.*

DYNABYTE 5300: HARDWARE COMPONENTS

CENTRAL UNIT .... The Dynabyte central unit, the Model 5100 computer, is housed in a single desk-top unit. It is based on the Z-80A processor and includes twelve S-100 bus card slots, two serial ports, and one parallel (printer) port. The unit can be expanded by the addition of a Quadraport or Octaport board in conjunction with a multi-user operating system (such as Dynabyte's DOS Level 4 based on the MP/M operating system). Additionally, the many S-100 based special purpose accessories can easily be added to the system.

CPU Memory: The 5100 comes with 64 kilobytes of central memory and can be expanded to 400 kilobytes (though special programming techniques are required to take advantage of this feature).

CRT/Keyboard: The Dynabyte Model 5022 intelligent terminal was supplied with the system. Though we used it as a dumb terminal (any of a number of brands would have worked in our application), the Dynabyte terminal contains twelve built-in and sixteen programmable function keys, as well as blinking, underlining, and reverse video.

OUR OBSERVATIONS

The system was simple to assemble (interconnecting of cables) and easy to operate. While we simply stacked our units on a desk top, Dynabyte does supply desk units where components can be mounted in the pedestal. The only controls for the operator are an on/off and a reset switch on the front of the panel. The rear panel contains space for the addition of twelve terminal ports which could be used for added terminals in a multi-user configuration.

One nice feature of the keyboard is the numeric/function keypad on the right-hand side. It includes a decimal, comma, and an enter key, so all data entry can be done without moving the hand (many terminals with a numeric keypad only have the decimal, so entering numbers with comma separators requires large hand movements.

USER COMMENTS

- *Speed is not all that great. The more terminals on-line, the slower it gets. I really like the Dynabyte. I use it in a physically dirty environment, dusty, and it hasn't given me any problems.*
- *For our purposes, no problems with speed. We never have all three terminals going at the same time. We're extremely pleased with it.*
- *We like the keyboard and screen very well.*

DYNABYTE 5300: HARDWARE COMPONENTS

STORAGE

The 5010 floppy disk system was used in our testing. Each disk controller board in the computer can support two auxiliary disk controller cards, which can each support eight disk drives. Thus, up to sixteen drives can be supported by using only one card slot in the computer itself.

The single density drives, in IBM 3740 format, each provide 256 kilobytes of storage. In double density recording (not IBM compatible), they each provide 512 kilobytes of storage, for a total of over 1 megabyte of on-line storage.

The 5015-12 hard disk unit, based on the Winchester technology with 8-inch disks, provides nearly twenty megabytes of formatted storage on-line. The unit comes in a case which matches the 5100 computer and 5010 floppy disk units.

OUR OBSERVATIONS

In addition to these units which we tested, Dynabyte has available a double-sided double-density floppy disk drive (for a total of up to two megabytes of storage), from 11 to 45 megabytes of Winchester hard disk storage, and fixed/removable cartridge disk units up to 96 megabytes.

As with many systems, a wide variety of hard disk storage means that a system can easily be configured to meet the needs of your application. Our caution, as always, is to buy more than you think you need in the way of storage. You will always find new applications, need file and program backups, and will find your data files growing faster than expected. Storage is relatively inexpensive, and insufficient storage should never become a bottleneck in your operations.

Hard disk storage should always be purchased where speed is a factor in choosing a system, particularly in small, micro-chip based systems. The more input/output intensive the application, the greater the benefit to be expected from a hard disk. In our I/O-intensive runs, the hard disk cut times by nearly two-thirds.

USER COMMENTS

- *Disk capacity is enough. The dealer recommended a 5¼" system, but within a month we ran out so we had to buy an 8" drive.*
- *Right now 27 megabytes is enough.*
- *We're going to have to add to our 8", we're pushing it right now.*

OTHER DEVICES

Printer: Dynabyte does not include any printers in their price list. A wide range of printers is available, any of which can be used on either the serial or parallel ports included with the system. We used the Epson MX80 for our testing.

OUR OBSERVATIONS

With the Z-80A/S-100 combination, a wide variety of accessories are available, ranging from clock boards to communication boards. One feature of the Dynabyte enhancement to the disk operating system is that they have written a modul to provide dial-up communications using one of two generally available modem (modulator/demodulator) boards.

USER COMMENTS

- *The Qume is fine.*
- *Really like the NEC printer. It works well with word processing and accounting package.*
- *I love the TI printer.*

DYNABYTE 5300: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES

Operating System:	Dynabyte DOS, an enhanced version of CP/M that contains all of the CP/M features, some simplified configuration utilities, and extensions. The multi-user MP/M is also available.
Languages:	Virtually anything you want since BASIC, FORTRAN, COBOL, PASCAL, and other languages are available under the CP/M operating system.
File Access Methods:	Under BASIC, we had sequential and random record methods. Other methods are available as utilities and data management systems running under CP/M.

UTILITIES

File Manipulation:	For file management, CP/M (Dynabyte DOS) allows creation and deletion, listing, editing, etc.
System Management:	System status, disk and file copy routines, formatting of disks, changing default input/output devices, are all available. An important feature of the Dynabyte is the utility DYNASYS, which is menu-driven and automatically configures CP/M. (A process which is time-consuming and error prone on any raw CP/M system).
Input/Output:	Under Dynabyte's DOS, it is possible to have up to 4 terminals and 4 printers tied to the system, though only one of each can be used at a time. The advantage of this is that several terminals and/or printers can be placed in different locations or have different characteristics, yet all can access or be accessed by the computer.

OUR OBSERVATIONS

The enhancements to CP/M are valuable, and other than these, DOS will work just like CP/M and includes all standard utilities and capabilities. The major advantage is the wide range of software available under CP/M which can also be used under Dynabyte's DOS. Their version 4 of DOS is based on MP/M, a multi-user operating system. Combined with the Octaport board, the system will support up to 8 simultaneous users.

USER COMMENTS

- *CBASIC is pretty good. Programs are not sufficiently customized for our business and it's too expensive to buy custom software. We've gotten really good software support.*
- *No training was needed because of our software (custom made). A person that has never been near a computer before can run it.*

DYNABYTE SUPPLIED PACKAGES

Dynabyte supplies a general business package, called Business Manager Modules. The modules consist of:

Sales Order Entry
Accounts Receivable
Inventory Control
Purchase Order Management
Accounts Payable
General Ledger

The six modules are linked together via common files (though not all modules must be used). They are menu-driven with form-fillout entry of data. Also linked to these modules is a Customer Information System which gives quick access to information in the files.

Dynabyte also features the WordStar word processing system which allows full screen editing, formatting (margins, justification, paging, etc.). This is a relatively popular word processing package available on many small systems.

OUR OBSERVATIONS

We did not use the Business Manager Modules and have no information on the maximum number of accounts, inventory items, etc., which can be handled by the system.

Dynabyte features the 5000 series as an expandable small business system, built around the Business Manager Modules.

USER COMMENTS

- *We've had virtually no problems with our application software, just with the level of documentation. The Dynabyte is suited very well to word processing. Other packages (third party/dealer) are evolving and getting better.*

- *No problems with WordStar. Peachtree packages had a couple of bugs but didn't need to be modified.*

EDITOR

With CP/M and the BASIC-80 we used, there were two options for editing programs and data:

The CP/M editor utility, ED
The interactive BASIC editor

Since we were using the compiled version of BASIC, we used the CP/M editor for program entry and the edit test. This editor, while line-oriented, does allow global searches and replacements of strings, line insertion and deletion, character insertion and deletion, listing of lines, appending of text, etc., are features of the system. These functions are accomplished by issuing commands to the editor, along with the required string information. The commands are single characters, sometimes preceded by a number. After using the system, these commands become memorized, but are difficult to keep in mind as you are learning the system.

The BASIC editor is strictly line-oriented with no global capabilities. A line number must be used for each program line, and editing consists of inserting and/or deleting characters and moving the cursor along the line.

OUR OBSERVATIONS

Most microcomputer program editors are not particularly good or easy to use, though the similarities among them are so great that having used one, the others are relatively easy to pick up. The problem is that the editors are designed to work with dumb terminals having no special function keys or features that can be used by an editor. Therefore, commands must use the normal alphabetic keys of the keyboard. There are only a few reasonable combinations of characters, like "I" for insert, "C" for change, "D" for delete, etc.

DOCUMENTATION

The working documentation consists of the CP/M manual and the BASIC-80 manual, neither of which are Dynabyte products. Various parts of the CP/M manual are designed for readers with different levels of expertise. The portions covering user interface and utilities are reasonably well done, though they don't teach much about computers. The system information is more complex and assumes a working knowledge of computers and software.

The BASIC-80 manual is designed as a reference manual covering the particular program statements included in this version of BASIC, as well as how to use the system in interactive and compile modes. Also covered are some utilities such as the linker, a cross reference facility, the editor, and the macro assembler, all typically included in a Microsoft BASIC system.

Dynabyte supplied manuals generally covered the hardware, along with their modifications to the CP/M software. We did not review the manuals on the Business Manager Modules.

MAINTENANCE

The system is marketed through a dealer network, and these dealers are responsible for maintenance. Service agreements are available.

TRAINING

The dealers are responsible for training, both in hardware and software use.

USER COMMENTS

- *Average problems for a computer. Super service.*
- *We had a lot of hardware problems, in fact, we had a whole new unit brought in. It's working all right now. Objectively I'd rate service very high. Minor problems with printer.*
- *No problems, pretty good service.*
- *Documentation is fair. Training was fair. There were a lot of things not explained. We used trial and error.*
- *Don't like Dynabyte manuals very much. Training was very good.*
- *Dynabyte documentation is excellent. We have good communications with and support from the manufacturer in California. Training has been inadequate.*

SUMMARY OF USER COMMENTS

With names supplied by Dynabyte, Inc., we interviewed nine users of the Dynabyte computer. It was being used for word processing, standard accounting procedures, mailing lists, inventory control, financial reporting and a database for a health agency hot-line. These organizations had owned the Dynabyte from two months to two years, with the average length of time one year. Users had evaluated many other computer systems before buying the Dynabyte. Very few people mentioned price as their primary reason for choosing Dynabyte but instead were influenced by the proximity of the Dynabyte dealer, the availability of application software and the multi-user capability.

There was no typical hardware configuration; two users owned two complete systems and three people reported that they had communications linked to the system. Central memory was usually 64 kilobytes but one user had 192K. Only one had 5¼" floppy drives, others had 8" floppy drives only or in combination with 23MB to 45MB hard disk storage. Two users had Dynabyte CRT's; others in use were Hazeltine, Intertube, and IBM. A third of the users had single user systems running under CP/M--the rest had two to five terminals with the MP/M operating system. There were a wide range of printers attached to the system including Texas Instruments, Diablo, IBM, NEC, DECwriter and Megasoft. One user was not happy with the quality of his Hazeltine CRT's and was planning on buying some "top-of-the-line" terminals. Generally the users with floppy disk storage indicated that they would need more storage capacity eventually, and for the rest, their present capacity was adequate.

After installation and the equipment had been broken in, the hardware was fairly reliable for this group. Several users had had major and prolonged problems but after these were cleared up the users then said the machinery was dependable. "It's been a good system, I think it's well designed, well built, attractive." Everyone said they received good hardware service and one user also said he was getting "super" service from his CRT's and printer.

Languages being used for the application software included CBASIC, Microsoft's BASIC-80, COBOL and FORTRAN. Only two users said they were doing programming in-house. Some businesses had packages developed for CP/M systems which included word processing programs. A user with Peachtree accounting programs said they had some "bugs" in them, but they "didn't really need to be modified."

It was in the area of application software that determined the users' fundamental feelings about the Dynabyte. Two users with identical businesses had found a software house that had "spent two years researching their business" and came up with programs that took care of every aspect of their operations. Needless to say, these two individuals were happy with the Dynabyte. Another user, though, was very displeased with his "off-the-shelf" packages and felt his business was just too diversified for them to work effectively. He couldn't afford custom programming and was looking for another system with software compatible with his business.

Those with multi-user implementations were divided about what they thought of the Dynabyte's speed of operation. A user with five CRT's was not doing program development but usually accessing a shared database, and said it was "very fast." Other users said they didn't run all the terminals at the same time, or were particular about how they scheduled tasks. One user with four terminals said "the more terminals on-line, the slower it gets." However, only one of these users felt that speed was a problem.

Some of the users thought Dynabyte's documentation was "excellent" or "fair," while others said they didn't need manuals because virtually all they did was turn it on and let the programs run. Training was good for some, inadequate or a matter of "trial and error" for others. In that critical area of dealer support, all but one user were getting the assistance they needed.

The Dynabyte was performing an important role in most of the users' businesses. They said the hardware was dependable, it was a capable multi-user system, application software was functional, and there was a good rapport between suppliers, service personnel and the owners. Two of these users, however, held a low estimation of the Dynabyte because of its size and the application software on the market which did not fit their needs. A few of the people who were more pleased with the Dynabyte made the following comments. "We didn't see a minicomputer that could do all this does." "I really like the Dynabyte. It holds up under abusive treatment."

CONCLUSIONS

The Dynabyte 5300 is based on the Z-80A processor, S-100 bus, and CP/M operating system. Additionally, we used the Microsoft BASIC-80 (compiled) in our benchmarks. There are many systems in this category and, performance wise, they are very similar. However, we are finding more and more competition among systems in terms of enhancements to the hardware and operating systems, and, as always, differences in levels of support.

The Dynabyte has two major enhancements to the operating system. First, up to four terminals and four printers can be connected to the system at one time, though only one of each can be in use at any one point in time. The second enhancement is a system generation utility that greatly simplifies reconfiguration as attachments (terminals, disks, printers, etc.) are changed or added to the system. Under CP/M, reconfiguration is a non-trivial task, but with this utility it is a very quick and easy process.

Users were happy with the performance of the Dynabyte, though some felt they were pushing its limits and might have to upgrade. Service was rated as excellent. The major areas of dissatisfaction (as with most small systems) were in training and documentation. Training is generally the responsibility of the distributor, and documentation the responsibility of the software developer. The technical documentation on the system was adequate, and the software documentation we used--written by Digital Research (CP/M) and Microsoft (BASIC-80)--were professionally done.

While we evaluated the Dynabyte 5300 as a single-user system, it does have multi-user capabilities under the MP/M operating system (Dynabyte's DOS Level 4) with the addition of the 4-port or 8-port input/output board, and additional memory. Combined with a hard disk (for faster disk access), the Dynabyte provides a relatively inexpensive entry level multi-user system with a wide range of available software, including Dynabyte's Business Manager series.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

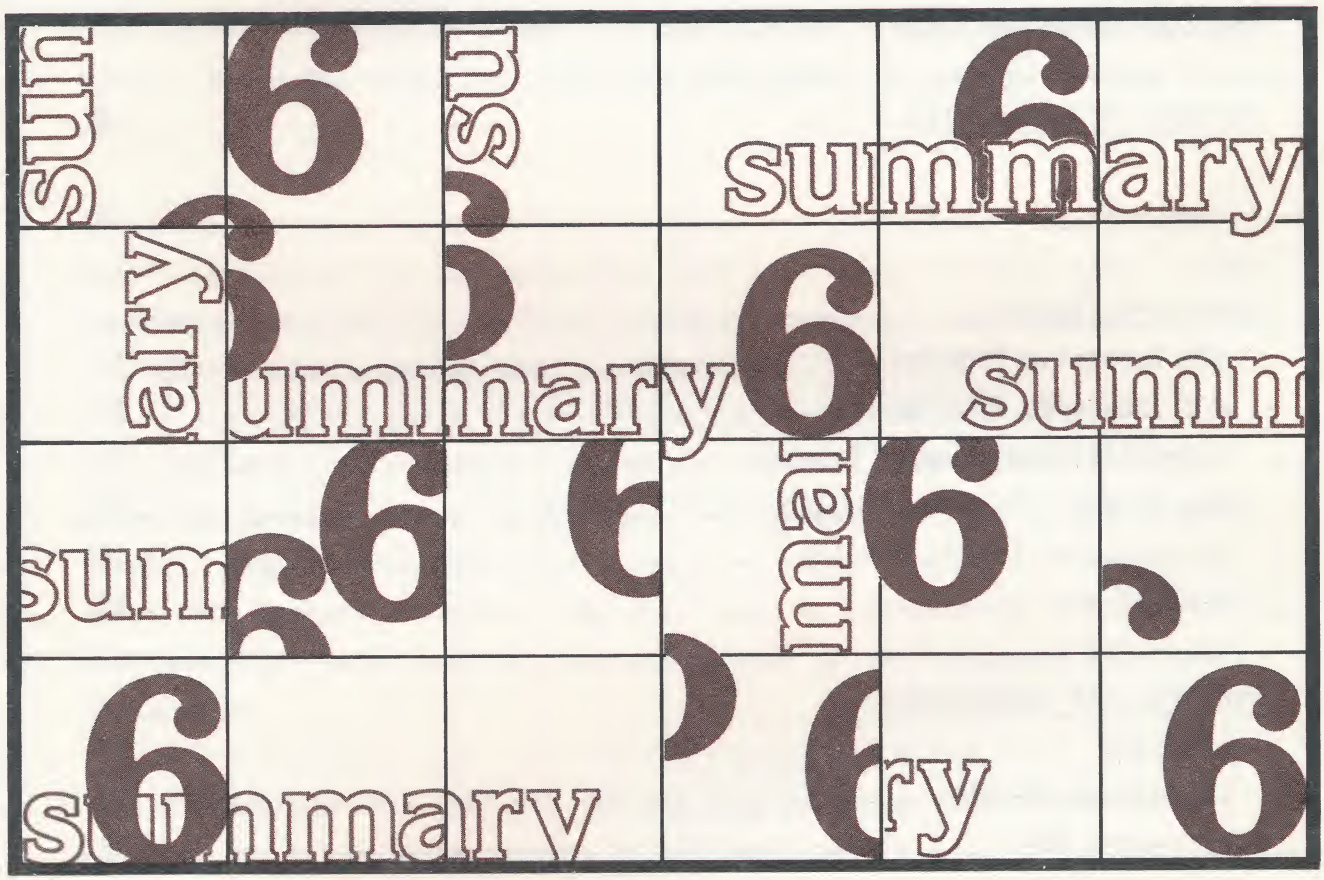
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 7, NOVEMBER 1981



6 Issue Summary

- *IBM 5120*
- *SD SYSTEMS SD-200*
- *WANG 2200SVP*
- *ALTOS ACS8000-15 & ACS8000-6*
- *NEC ASTRA 205*
- *DYNABYTE 5300*

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

S I X - I S S U E S U M M A R Y R E P O R T

TABLE OF CONTENTS

	Page
Preface	3
Overview of Systems	4
Comments on Overview	5
Using Benchmark Results	6
Hardware Criteria List	8
Software Criteria List	10
Benchmark Problems	
CPU Intensive Problem	11
I/O Intensive Problem	12
Scientific/Engineering Problem	13
New Product Planning Problem	14
Accounts Receivable Problem	15
Ease of Use Test	16
Profiles and Conclusions	
IBM 5120	17
SD Systems SD-200	18
NEC Astra 205	19
Altos ACS8000-15	20
Wang 2200SVP	21
Dynabyte 5300	22
Summary	23

PREFACE

The Business Research Division has, over the past six months, reviewed six microcomputers in the under $25,000 price range. Our reports have included quantitative and qualitative data designed to provide information which would be useful to a prospective purchaser in choosing from among the many possible alternatives.

The principal quantitative data is provided by running benchmark programs on each of the systems under study. These programs, written by Real Decisions Corporation, were designed to answer specific questions concerning the CPU, disk access, and printer speeds and capabilities. This technical test provides a basis for comparing computing performance in an applications environment.

In addition to the benchmark test results, we report on the technical factors which are inherent in the equipment, such as storage and main memory limits, peripheral availability, software features, operating system characteristics, and other vendor provided specifications.

The qualitative data consists of our own personal observations on ease of use, potential problem areas, limitations, and notable features of the computer system. Additionally, we include comments, observations, and experiences of users whom we have surveyed, including their satisfaction with the equipment, problems which have occurred, and suitability of the equipment for their application.

This summary report highlights the key points discussed in the first six reports. Each benchmark program is outlined and the results compared across computers. Then, each computer system is discussed and ranked on each of the benchmark tests. Finally, the best and worst features of each system are mentioned.

Please note that we are not recommending any particular computer system since each has advantages and disadvantages. Every individual must make their own choice based upon their own needs, applications, and importance of choice criteria.

OVERVIEW

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
COST	$13,705	$12,300	$11,950	$9,875	$14,600	$8,535
PRIMARY USAGE	Bus./Sci. General	Bus./Sci. General Word Proc.	Business	Bus./Sci. General Word Proc.	Bus./Sci. General Word Proc.	Bus./Sci. General Word Proc.
CPU						
Type	---	Z-80A	---	Z-80A	---	Z-80A
Memory Size	32K (up to 64K)	64K (up to 256K)	128K (up to 256K)	208K	32K (up to 64K)	64K (up to 400K)
BUS	---	S-100	---	---	---	S-100
DISK STORAGE						
Standard Capacity	2.4MB	2MB	2.4MB	1MB	3MB	1MB
Expandable to:	4.8MB	96MB	4.8MB	76MB	5MB	96MB+
Hard Disk Capability	No	Yes	No	Yes	Yes	Yes
SCREEN						
Size	16 x 64	24 x 80	24 x 80	24 x 80	24 x 80	24 x 80
Graphics	No	No	Some	No	Some	No
Multi-terminal capability	No	Yes	No	Yes	No	Yes
LANGUAGES	BASIC AP/L	All CP/M Languages	BASIC COBOL	All CP/M Languages	BASIC-2	All CP/M Languages
SOFTWARE						
Mfg. Package	None	Some	Some	None	Some	Some
Vendor Package	Yes	Extensive	Yes	Extensive	Yes	Extensive
Documentation	Satis-factory	Below Average	Satis-factory	Satis-factory	Above Average	Satis-factory

COMMENTS ON OVERVIEW

- The IBM, NEC, and WANG all have proprietary CPU and internal bus structures. The others are Z-80A CPU's. The SD Systems and Dynabyte have S-100 bus structures.

- The three Z-80A based machines used the CP/M Operating System from Digital Research, opening up a wide range of languages and applications which are written for this system. However, this is not always an advantage since much of the software is unreliable. Also, the more a vendor relies on externally supplied software, the greater the "finger-pointing" syndrome (is it a hardware of software problem?).

- Memory size does not indicate how much memory is available to the user. In the CP/M based systems, approximately 8K bytes of storage is taken by the CP/M system, and, depending upon the particular memory boards, from 2K to 8K bytes of memory are used for the disk drivers. In the NEC, a very large portion of the memory is utilized by the operating system. In the WANG, the operating system is a separate memory and is not counted in memory size. For the IBM, 4K bytes out of a 32K memory size is used for system overhead.

- We are seeing in this series a trend towards multi-user capabilities on the small machines. Some CP/M based systems can be expanded to MP/M, though additional memory is usually required. However, in our opinion, these expanded systems are more difficult to program and do not have the features normally found in an integrated multi-user system, though they do provide an inexpensive entry-level system for the small business.

- Hard disk capabilities are becoming more prevalent on the smaller machines, and significantly speed up processing times where file input/output is heavily used.

- Though prices are going up--the average price of these six machines was $11,900--capabilities are expanding even faster. In terms of computing power per dollar, you can spend less and get more today than you could only a year ago. The real cost today is in software, and prices will continue to rise since it is a labor-intensive industry.

USING BENCHMARK RESULTS

The effective evaluation of a computing system involves the consideration of a number of criteria including, but not limited to, our benchmark system results. Though these times provide important information concerning the processing capabilities of a computer system, other factors included in the body of our reports must be considered. Some of the criteria we consider important are:

- What is the maximum capacity in terms of memory and disk?
- What software is available for the system, and is it applicable to my business needs? Is it easy to use?
- How comfortable do I feel about the dealer? Is the dealer geographically close to my location? Will the dealer respond to problems? Is the dealer competent to handle problems?
- What is the overall support structure? Maintenance? Warranty? Training? Documentation? Will I get system updates and modifications? How much extra will it all cost?
- What impact will it have on my business operations? Installation? Policies and procedures? Personnel changes? Physical requirements?
- Will the added information and reports, faster report generation, and better customer service be worth the costs?

Alternative systems should be rated on these criteria and compared against the system requirements (as set by you, the prospective purchaser) before a final choice is made. One method we have found useful in the evaluation process consists of the following three steps:

1. Set certain minimum standards or capabilities, and eliminate from further consideration any system not meeting the minimum requirements.
2. Rank order, from most to least important, all of your selection criteria, and rate each vendor/system on each criterion (perhaps using a seven-point scale from very bad to very good).
3. Now compare the systems on only the few most important criteria. Is there a clear best system? If there is, that's your choice. If not, look at additional criteria until you find a clear winner.

For many applications, there may be no best system since any system with more of some desired feature will have less of some other desired feature. That is why the choice must be made by first defining minimum standards and then rank ordering the criteria. Unfortunately, we have seen individuals who keep waiting for the non-existent best to come along, and they never automate ... and they never realize what the lost opportunity is costing them.

CPU INTENSIVE PROBLEM

PROBLEM STATEMENT

These two programs execute a variety of calculations. The first program (timings A-1 to A-4) uses addition, multiplication, division, square root and exponentiation. The second program (A-5 to A-8) uses just addition, multiplication, and division. Each program runs through an iterative process N times, with N values of 500, 1000, 2000 and 3000.

RESULTS

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
Parameters						
A-1 N = 500	21.4	39.6	--*	2:24.2	2.7	2:15.3
A-2 N = 1000	41.8	1:17.4	--	2:43.5	5.2	2:35.7
A-3 N = 2000	1:22.9	2:23.0	--	3:25.2	10.2	3:16.6
A-4 N = 3000	2:03.9	3:48.0	--	4:05.9	15.2	3:57.2
A-5 N = 500	24.9	11.0	5:18.7	2:06.0	2.4	1:54.6
A-6 N = 1000	48.9	20.4	5:53.3	2:08.4	4.5	1:57.3
A-7 N = 2000	1:37.3	39.1	7:02.5	2:13.1	8.8	2:02.0
A-8 N = 3000	2:25.5	57.8	8.11.8	2:17.8	13.0	2:06.6

*NEC's BASIC language does not have square and square root functions.

OBSERVATIONS & COMMENTS

- The NEC, Altos, and Dynabyte were all compiled languages, and these times include compile, link, and execute, giving an indication of speed in program development mode. For run only times, NEC is still the slowest, while Altos and Dynabyte fall between the SD-200 and Wang.
- Wang shows here its fast processing capabilities.

I/O INTENSIVE PROBLEM

PROBLEM STATEMENT

This run stores numbers from 1 to N on disk and retrives the first 50 of them in a factorial fashion (for example, for a total of 1275 reads following 3000 writes). The program was run with N set at 500, 1000, 2000 and 3000.

RESULTS

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
Parameters						
B-1 N = 500	2:23.6	1:07.8	6:59.8	2:33.9	7.6	2:40.9
B-2 N = 1000	2:43.3	1:15.0	7:12.5	2:39.2	10.6	2:48.5
B-3 N = 2000	3:20.9	1:30.9	7:24.8	2:49.3	16.9	2:57.0
B-4 N = 3000	3:58.0	1:49.3	7:45.9	3:01.7	23.0	2:67.2

OBSERVATIONS & COMMENTS

- NEC, Altos, and Dynabyte were compiled. For run only times, NEC was slightly better than IBM, while Altos and Dynabyte fell between SD Systems and Wang.
- Hard disk systems greatly improve timing on this test, cutting times to one-third or better.

SCIENTIFIC/ENGINEERING PROBLEM

PROBLEM STATEMENT

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$
\begin{aligned}
0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N &= 0.2 \\
0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N &= 0.4 \\
0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N &= 0.6 \\
\vdots \qquad\quad \vdots \qquad\quad \vdots \qquad\quad \vdots \qquad\quad \vdots \qquad\quad \vdots & \\
0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N &= 10.0
\end{aligned}
$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

RESULTS

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
C-1	35:29.7	17:42.8	20:18.8	7:54.5	2:13.3	7:43.7

OBSERVATIONS & COMMENTS

- With run only times, NEC drops to 14 minutes, and the Altos and Dynabyte drop to 5½ minutes.
- It should, by now, be clear that the Altos and Dynabyte are very close in all times, They are Z-80A's running at the same clock speed, and using the same compiled BASIC-80.

PROBLEM STATEMENT

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established, and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

RESULTS

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
C-2	25.0	10.5	8:32.3	2:30.6	5.2	2:22.2

OBSERVATIONS & COMMENTS

- On run only times, the NEC was 38 seconds, and the Altos and Dynabyte were 8 seconds.
- Times for printed output varied from one-half to one and one-half minutes, depending upon the printer speed.

ACCOUNTS RECEIVABLE PROBLEM

PROBLEM STATEMENT

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding, and sales by month.

RESULTS

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
C-3	4:16.2	6:16.4	26:26.4	10.41.5	2:23.0	11:01.5

OBSERVATIONS & COMMENTS

- NEC's run only time was just over 5 minutes, while the Altos and Dynabyte were close to the IBM's time.
- With printed output, times increased by approximately one to three minutes, again depending upon the speed of the attached printer.

EASE OF USE TEST

PROBLEM STATEMENT

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

RESULTS

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
Number of key-strokes required	134	208	125	208	162	208

OBSERVATIONS & COMMENTS

- The better scores of the IBM, NEC, and Wang indicate the integrated nature of these systems, including better editors than the CP/M editing utility.

PROFILE: IBM 5120

Price as tested = $13,705

BENCHMARK STANDINGS ....

	CPU	I/O	SCI/ ENG	NEW PROD	ACCTS REC	EDIT
	A	B	C-1	C-2	C-3	E-1
Fastest 1						
2	X				X	X
3				X		
4						
5		X				
Slowest 6			X			

Comment: The 5120's timings ranged from fairly fast to the slowest.

BEST FEATURES .... IBM has provided a powerful BASIC that includes a wide range of mathematical functions. An abundance of function keys aid programming and data entry. IBM does supply a variety of application programs.

DRAWBACKS ..... There is too much overlap and redundancy in IBM's manuals which make them a time-consuming reference. The 5120 is a single-station system which cannot support hard disk or additional users. Although IBM provides software, they will not tailor it for a user. Some users mentioned that the small screen size was a hinderance and that the 80 cps printer slowed throughout.

CONCLUSIONS ..... As a floppy-based, non-expandable system, the 5120 is somewhat overpriced. One of its strongest points is IBM's national network of representatives with a respectable reputation for service. The 5120 will be utilized best by a company that buys turnkey programs or has an experienced computer user in-house.

UPDATE ..... As of October 1, 1981, the price of the 5120 has been reduced 35 percent. However, the new IBM System/23 effectively replaces the 5120 at the bottom of IBM's product line. The System/23 is a single-user system expandable to 128K of main memory and 4.4 megabytes floppy disk storage.

PROFILE: SD SYSTEMS SD-200

Price as tested = $12,300

BENCHMARK STANDINGS ....

	CPU	I/O	SCI/ ENG	NEW PROD	ACCTS REC	EDIT
	A	B	C-1	C-2	C-3	E-1
Fastest 1						
2		X		X		
3	X				X	
4			X			X
5						
Slowest 6						

Comment: The SD's times put it in the middle among the other six systems, however, it was the fastest of the three Z-80A computers.

BEST FEATURES .... Users were pleased with the SD's hardware reliability and ease of use. It has a Z-80A processor running under an operating system that is CP/M compatible. SD supplies some business packages and supports many vertical software packages. A user can choose floppy disk drives or up to 96 megabytes hard disk and add up to five terminals.

DRAWBACKS ..... The documentation is some of the poorest we've seen; users expressed the same opinion and said it was too technical. Although there is an additional Z-80A chip dedicated to screen use, "user friendly," or extra capabilities have not been implemented and screen output is very basic.

CONCLUSIONS ..... The SD is a very solid system and a capable performer, however its price is higher than other systems tested in this series with the same capabilities. It's expandability will make it attractive for a small and growing business. First-time computer users will want to purchase finished programs as the documentation would make learning about programming and modifying programs difficult.

UPDATE ..... The SD 200 is now being marketed with the OASIS operating system. SD Systems is also modifying the MP/M multi-user operating system to run on SD computers.

PROFILE: NEC ASTRA 205

Price as tested = $11,950

BENCHMARK STANDINGS ....

		CPU	I/O	SCI/ ENG	NEW PROD	ACCTS REC	EDIT
		A	B	C-1	C-2	C-3	E-1
Fastest	1						X
	2						
	3						
	4						
	5			X			
Slowest	6	X	X		X	X	

Comment: The NEC was one of the slowest systems we tested, but it has a superior editor.

BEST FEATURES .... The Astra 205, while not expandable, is upward compatible within the Astra line. It is an integrated system that is host for an assortment of NEC supplied business packages. The application documentation is well done. The 205 is fairly versatile; it has 27 function keys and a screen-oriented BASIC.

DRAWBACKS ..... The operating system is designed for larger and more powerful systems. This design, combined with a COBOL-like structured BASIC requires a higher level of user expertise. We found the system documentation difficult to use, some manuals lacked indexes and it was loosely organized. Compile time was long since the compiler seemed to make excessive use of the disk for intermediate storage.

CONCLUSIONS ..... The NEC will work well for a user who does not intend to program or expect to modify third-party programs. The thrust of the documentation and support from the manufacturer is toward dealers and software suppliers, so a careful assessment of the potential dealer is advised.

UPDATE ..... System price has dropped from $8,560 to $6,500. The total cost with a 120 cps printer is $9,890. The cost of adding a third 1.2 megabyte drive has gone down $1,000.

PROFILE: ALTOS ACS8000-15

Price as tested = $9,875

BENCHMARK STANDINGS ....

		CPU	I/O	SCI/ ENG	NEW PROD	ACCTS REC	EDIT
		A	B	C-1	C-2	C-3	E-1
Fastest	1						
	2						
	3		X	X			
	4					X	X
	5	X			X		
Slowest	6						

Comment: The Altos' times are in the middle and comparable to other Z-80A systems, but in the slower group overall.

BEST FEATURES .... Numerous upgrade options, including hard disks and multi-user capability, allow the Altos to easily grow with a business. It employs a unique single board technology eliminating the need for an internal bus. Users reported that the hardware was reliable and backed up by good service from dealers. It runs under the CP/M operating system, giving the user an almost unlimited supply of software packages and languages.

DRAWBACKS ..... Altos does not "package" their system, a buyer, therefore, should be careful when choosing peripherals, making sure they are compatible with the system. Most of the documentation is not well suited for a beginning computer user.

CONCLUSIONS ..... Costing under $10,000, the ACS8000-15 is a cost-effective, versatile system. It is reliable and can service a variety of applications with the large array of CP/M programs on the market.

PROFILE: WANG 2200SVP

Price as tested = $14,600

BENCHMARK STANDINGS ....

		CPU	I/O	SCI/ ENG	NEW PROD	ACCTS REC	EDIT
		A	B	C-1	C-2	C-3	E-1
Fastest	1	X	X	X	X	X	
	2						
	3						X
	4						
	5						
Slowest	6						

Comment: *The SVP continues the Wang tradition of computers that outshine many others, it is a very fast system.*

BEST FEATURES .... Users were very pleased with the SVP. They said it was fast, BASIC-2 was powerful and easy to learn, and system documentation was reported to be above average. A total capacity of 4 megabytes hard disk and one megabyte floppy disk storage is available. It has features for experienced and non-experienced users alike and has programmable function keys.

DRAWBACKS ..... Anyone purchasing the SVP must keep in mind that it is a single-user system only. Some users felt a drawback was the lack of a large application product base that could run on the Wang. BASIC-2's file handling methods are quite awkward and do not allow random accessing.

CONCLUSIONS ..... The SVP has some powerful capabilities that are somewhat diminished by clumsy file handling. For number crunching capability it is superior. The fixed size makes it suitable for a small business or a single-task application. For $1,000 more, the Wang 2200VP would give a user an upgradable system.

PROFILE: DYNABYTE 5300

Price as tested = $8,535

BENCHMARK STANDINGS ....

	CPU	I/O	SCI/ ENG	NEW PROD	ACCTS REC	EDIT
	A	B	C-1	C-2	C-3	E-1
Fastest 1						
2			X			
3						
4	X	X		X		X
5					X	
Slowest 6						

Comment: The Dynabyte's performance put it in the slower rankings overall, but its times are comparable to other Z-80A processors.

BEST FEATURES .... The 5300 is a Z-80A system expandable to hard disk and multi-users. Additionally, with a single-user configuration, up to four printers and four terminals may be attached, although only one of each may be used at a time. The operating system is an enhanced version of CP/M and is compatible with CP/M packages and languages. Users reported that the Dynabyte hardware required only minor repairs and servicing.

DRAWBACKS ..... Documentation is not produced by Dynabyte, so there is a variability in the quality of manuals and useability by different users. Owners' dissatisfaction with the system was usually a result of their application software.

CONCLUSIONS ..... It is a relatively low priced system with "room to grow" with a business. Versatility is provided by the many options offered by CP/M compatible packages and languages on the market.

UPDATE ..... The processor and dual 8-inch drives each cost about $400 less now: total price is $800 lower.

SUMMARY

This summary report has reviewed the best features and drawbacks of six small systems. Additionally, we have included updates indicating features and prices which have changed since our original reports. Finally, the systems have been ranked in terms of performance on the six benchmark programs.

There are advantages and disadvantages to each of the systems tested. Some are faster; some have larger storage capacities; some have more application software available; some have graphics capabilities; some are less expensive; some can be expanded to multiple terminals; some have several programming languages available; some have more hardware options; and some take up less space.

It is unlikely that any one system possesses the best combination of features for your application. The key word here is best. Only you can determine what is best for your application, operating environment, and growth expectations. You must determine which features are "musts," which are "nice-to-haves," and which are "immaterial." Since every system you look at will have some unique feature, and if you haven't clearly specified your needs, then every sales pitch you hear will be more likely to add to your confusion.

In choosing a system, we would make two recommendations. First, if you don't know much about computers, it would be worthwhile to have a consultant spend a few days in your business to analyze your needs, and to tell you what options are available in the way of equipment and software. You should be willing to spend ten percent of your budget on outside, independent help in choosing a system.

Our second recommendation is that you not underestimate system size requirements. Users often comment that they need to add memory, terminals, and/or disk space, simply because they have found more applications or have grown faster than anticipated. You should use a two to three year planning horizon when considering system size.

We will be reporting on an additional six systems, and by the end of this series, you will have a good understanding of the capabilities and features of the major small systems available in today's marketplace.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

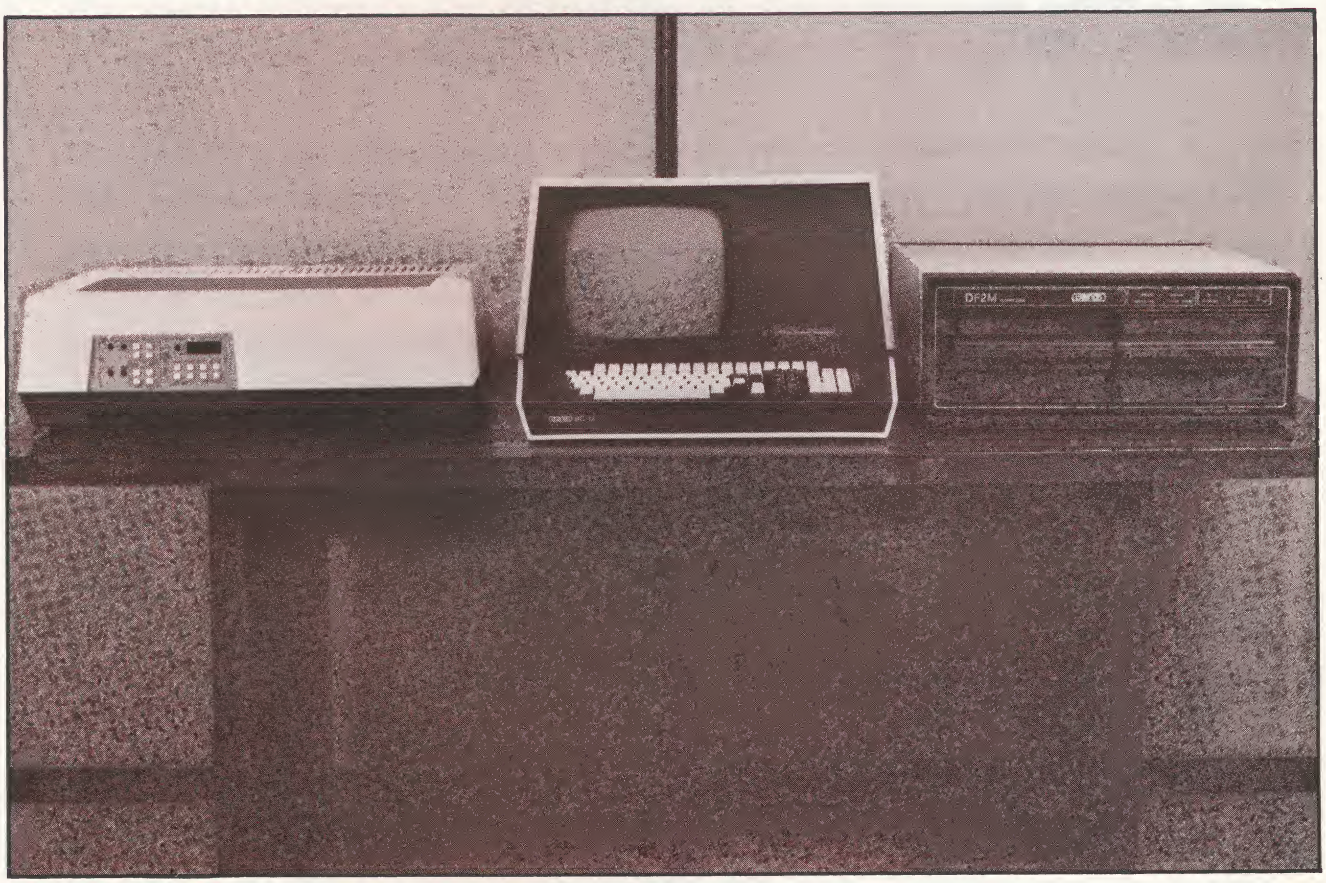
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 8, DECEMBER 1981



In This Issue:

The BILLINGS BC-12 DF2M

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

BILLINGS BC-12DF2M

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: Billings BC-12DF2M	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

Our seventh report in the Continuation of Series 1 and 2 covering systems under $25,000 evaluates the Billings BC-12DF2M. To date, we have looked at systems that could be classified as stand-alone floppy-based machines that may or may not be expandable to hard disk and multi-user configurations. Often, this type of system is the only computer made by a particular manufacturer. Other systems were developed by manufacturers that designed and sold larger systems, but are now offering smaller (often non-expandable) computers to fill out the low end of their product lines. The Billings BC-12DF2M examined in this report belongs in the first group, as this floppy-based system is the primary computer marketed by the Billings Computer Corporation.

Although there are differences in philosophies about hardware design, a feature that is becoming more and more common across all systems is application software developed and supported by the hardware manufacturers themselves. These packages can help to lower the costs of computer ownership by eliminating the need for custom programming. Though not without some disadvantages, these packages should be one of the key components a buyer examines closely.

Our benchmark reports continue to be a valuable resource for sifting through the often subtle differences among small computer systems. These reports provide the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. Additional information is given on the alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on ease of use. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report.

EXECUTIVE SUMMARY

The Billings BC-12DF2M used in our tests consisted of a Z-80A microprocessor, 64 kilobytes of main memory (56K bytes available to the user), two dual-sided, double density floppy disk drives (2 megabytes total), two RS232C serial I/O ports, a 24-by-80 character CRT, and a P-510 printer (a 180 character-per-second dot matrix printer). The total system price including Billings Operating System (BOS) and Billings EBASIC is $12,395.

- The Billings BC-12DF2M is another system in this series which is based on the ever popular Z-80A processor. The processor, memory, and other boards are mounted in the terminal as a single, compact, lightweight unit (the BC-12). The drives are contained in a separate unit (the DF2M).

- The Billings Operating System (BOS) is based on the single-user version of the OASIS operating system by Phase One Systems. Billings has enhanced and upgraded OASIS to create their system, BOS. Our past experience with this operating system has been extremely favorable and BOS was no exception. We feel this operating system is one of the most sophisticated offered for microcomputer systems. Its features are often found only on more expensive minicomputers.

- The users we spoke to in our survey described the performance of the Billings system as "adequate" and "acceptable" and our benchmark timings agree with this appraisal. Though these users may not have been impressed with the Billings' speed, they nearly all agreed that for the money, its performance was good.

- Billings offers a full line of application software including the "big five" accounting packages, word processing, and several others. We had an opportunity to try out these packages and found them to be well designed and easy to use. Though the users in our survey reported some problems with the packages, most were quite pleased.

- Billings offers several languages for the BC-12DF2M including FORTRAN, COBOL, Macro Assembler, and two different versions of BASIC. They also offer screen and printer forms generators which greatly facilitate application programming.

- The users we surveyed were overwhelmingly pleased with the reliability of their Billings hardware. They were also nearly unanimous in their satisfaction with the support received from their Billings dealers. They regarded their dealers as "knowledgeable" and "supportive."

Though its expansion capabilities are limited, the Billings BC-12DF2M is a capable computer system for the small business user. With reliable hardware, a variety of application packages, and capable dealers, the Billings system could be "just right" for the entry-level user.

BENCHMARK REPORT

SYSTEM: BILLINGS BC-12DF2M

PRICE AS TESTED: $12,395

SPEED TESTS

Benchmark Number		TOTAL TIME Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500		48.3
A-2	N = 1000	1	34.5
A-3	N = 2000	3	6.9
A-4	N = 3000	4	39.2
A-5	N = 500		13.3
A-6	N = 1000		24.3
A-7	N = 2000		46.5
A-8	N = 3000	1	8.6
	I/O INTENSIVE		
B-1	N = 500	1	45.0
B-2	N = 1000	1	55.1
B-3	N = 2000	2	29.1
B-4	N = 3000	3	0.3

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	21	48.6
C-1A		7	52.9
C-2	NEW PRODUCT PLANNING		14.2
C-2A			36.6
C-3	ACCOUNTS RECEIVABLE	5	9.2
C-3A		5	49.5

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	208
E-2	SUBJECTIVE JUDGMENT	Easy

THE BENCHMARK PROCESS

All benchmarks were run using Billings' EBASIC under the Billings Operating System (BOS). The Billings BC-12DF2M used in these tests consisted of a Z-80A microprocessor with 64 kilobytes of main memory (56K available to the user), two 8-inch floppy disk drives with a total capacity of 2 megabytes, a CRT/keyboard, and a 180 character-per-second dot matrix printer. Billings shipped the unit to our offices in Boulder, Colorado where the system was quickly made operational with the help of Billings personnel.

The BOS operating system is designed for the BC-12 system and therefore requires no personalization or other set-up procedures. In fact, the operator need merely power-up the system and insert the proper diskette to start the system. We found the BOS Reference Manual to be quite helpful and easy to use with each command clearly explained and numerous examples provided. In addition, a HELP command is available at any time to explain operating system commands at the terminal.

Billings' EBASIC has its roots in Microsoft's BASIC-80. Billings has purchased the rights to BASIC-80 and modified it for the BC-12. Since we have had a great deal of experience with BASIC-80 in the past, we were immediately comfortable with EBASIC. We found the Billings manual on EBASIC to be very good and stocked with numerous examples of EBASIC commands and statements. As is common, though, the user must be aware that this manual is intended for reference and not as a learning tool.

Before the benchmark programs could be run, some modifications were required to adapt them to Billings EBASIC. Typically, the major differences in versions of BASIC are in the area of I/O statements and EBASIC was no exception.

Some of the features of EBASIC include:

- Sequential and random file access
- If . . . Then . . . Else (with nesting)
- Direct (or immediate) execution of statements
- Program editing facilities including an EDIT command, a renumbering facility, an automatic line numbering facility
- Assembly language subroutine calls

As with BASIC-80, EBASIC does not do immediate syntax-error checking (i.e., as the statements are entered). Instead, syntax errors are detected as encountered during program execution and EBASIC places the user in EDIT mode on the incorrect line.

All programs were run with output to the screen. For those programs having printed output, a control sequence (Escape followed by a P) can be entered to echo all screen output to the printer. Alternatively, the EBASIC LPRINT statement can be used to directly output to the printer. We used the latter method, though we noted that less than a second was added to the execution time if we used the control sequence rather than the LPRINT.

To run the benchmark tests, the programs were entered using the EBASIC interpreter and editor, tested, and stored on diskette. To execute, the programs were loaded into memory, the RUN statement was typed in, and the stopwatch was started when the carriage return was entered. Timing was stopped when output was complete.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500		48.3 seconds
A - 2		N = 1000	1 minute	34.5 seconds
A - 3		N = 2000	3 minutes	6.9 seconds
A - 4		N = 3000	4 minutes	39.2 seconds

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500		13.3 seconds
A - 6		N = 1000		24.3 seconds
A - 7		N = 2000		46.5 seconds
A - 8		N = 3000	1 minute	8.6 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disks and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500	1 minute	45.0 seconds
B - 2		N = 1000	1 minute	55.1 seconds
B - 3		N = 2000	2 minutes	29.1 seconds
B - 4		N = 3000	3 minutes	0.3 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$
$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$
$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	21 minutes 48.6 seconds

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results	7 minutes 52.9 seconds

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

C - 2 | Results: 14.2 seconds

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A | Results: 36.6 seconds

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3 | Results: 5 minutes 9.2 seconds

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results:	5 minutes 49.5 seconds

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a nine-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1	Results:	Approximately 208 keystrokes were required to edit the nine-line test file.

BILLINGS BC-12DF2M: PRICING COMPONENTS

COST

Billings BC-12DF2M, as tested $12,395

Includes:
- Z-80A processor
- 64 kilobytes of main memory (56k for user)
- Two dual-sided, double-density floppy disk drives (8-inch) for 2 megabytes total storage
- 2 RS232C serial I/O ports
- CRT and keyboard
- P-510 180 character-per-second dot matrix printer
- Billings Operating System
- Billings EBASIC

Components

- BC-12 (terminal, processor, memory, and ports) ..... $ 5,400
- BC-12FD (BC-12 plus dual 5¼-inch floppy disk drives) ..... $ 6,600
- BC-12DF2M (BC-12 plus dual 8-inch drives) ..... $ 9,900
- DF2M (dual 8-inch floppy disk drives) ..... $ 4,500
- P-55 (55 character-per-second impact printer) ..... $ 3,100
- P-110 (110 character-per-second dot matrix printer) ..... $ 749
- P-510 (180 character-per-second dot matrix printer) ..... $ 1,595
- Billings Operating System ..... $ 500
- Billings EBASIC ..... $ 400

OUR OBSERVATIONS

The Billings system is sold through a network of dealers. These dealers were generally rated quite high by the users we spoke to in our survey.

Expansion capabilities are relatively limited on the BC-12. In our discussions with Billings personnel, they indicated that they are not at this time contemplating addition of hard disk capability to the BC-12 system.

USER COMMENTS

- *I can't get more central memory without spending a lot of money.*
- *Overall, the equipment is excellent, but the information that comes along with it really needs work.*
- *I love the Billings!*
- *I think it's a good system . . . they've been raising their prices.*
- *I like it. It's easy to work with and relatively free of problems.*

BILLINGS BC-12DF2M: HARDWARE COMPONENTS

CENTRAL UNIT .... The BC-12DF2M is an 8-bit, 4 MHz system with a Z-80A processor, 56 kilobytes of central memory, a 12-inch CRT, and a typewriter keyboard, all housed in the terminal which is 20" x 8" x 23". It is RS232 compatible with two ports and a 23-bit parallel TTL I/O port.

CPU Memory: The Billings comes with 56 kilobytes of user memory, an additional 8K is reserved ROM.

Keyboard/Screen: The 12-inch CRT has 96 ASCII and 32 graphics characters which can be used with reduced intensity or reverse video. The cursor is a blinking underscore. The keyboard has 94 keys plus sixteen function keys and a separate 10-key numeric pad.

OUR OBSERVATIONS

Exact memory locations for such programs as DEBUG, ATTACH, and the Editor will "float." That is, they will fill out as much memory as required and/or is available.

We found the terminal keyboard layout to be very easy to use and the video screen an "easy-on-the-eyes" green phosphor. A detached keyboard would be nice, though we concur with most of the users we spoke to who were quite satisfied with the terminal.

USER COMMENTS

- *I like the keyboard, especially the word processor function keys.*
- *Speed is adequate for what we do. Overall, I'm quite happy with it.*
- *The keyboard and screen are very acceptable, easy to use.*
- *No major hardware problems, fine service (owned it three years). It is fantastically reliable. For a micro, speed is good.*
- *Good features are the function keys and expandability. Worst is speed.*
- *Central memory is not enough, we wish we could get more. It's an inconvenience. The system is very slow. They say the 8-inch is faster.*
- *Sometimes when I'm doing long math functions, I run out of RAM. Speed is adequate, long assemblies take awhile. Best part is that I can do a lot of different things with it.*
- *Central memory is enough. Speed is very acceptable, plenty fast. We're very very satisfied with it. It is generally easy to use.*

BILLINGS BC-12DF2M: HARDWARE COMPONENTS

STORAGE

The Billings BC-12DF2M comes with two dual-sided, double density 8-inch floppy disk drives. These drives, housed in a separate cabinet, provide 2 megabytes of storage.

Billings also offers the BC-12FD system. This system differs from the BC-12DF2M in that it employs dual 5¼-inch floppys for a total storage capacity of 630 kilobytes.

OUR OBSERVATIONS

Billings does not offer hard disk drives for their BC-12 system. Though one Billings dealer does support the use of Century Data's Winchester drives on the BC-12, Billings itself does not directly support their use. We feel that this is an unfortunate, and significant, drawback of the BC-12, especially for the user who needs a system which expands as the business expands.

One feature of the DF2M drives that we think is especially useful, is the ability of the system to sense when the drive doors have been closed. This allows applications to be written so that when the user inserts the proper disk and shuts the drive door, the application loads and executes. The user is not required to enter any statements to "boot the system" or begin execution of a program. Billings' applications take advantage of this feature so the unsophisticated user need only learn how to insert diskettes into the drive to start-up applications (the application can guide them from then on).

USER COMMENTS

- *For long tasks and document processing, we can link diskettes together indefinitely.*
- *Eventually, we'll need the eight-inch drives.*
- *I wish we had the eight-inch drives instead of the 5¼ inch . . . though it hasn't really held me back.*
- *So far the eight-inch drives have been enough, but we might need more storage in the future.*

OTHER DIVICES

Printers:

P-510	180 characters-per-second Bidirectional, wire matrix, impact 96 ASCII character set 132 characters per line Double width enhanced print 15" wide paper width, maximum Prints on the original and 4 copies
P-110	100 characters-per-second
P-55	NEC Spinwriter 55 characters-per-second

C-1200 Communications Modem

Can be used with Billings' Document Communicator to transfer documents between two computer systems over regular telephone lines.

OUR OBSERVATIONS

The P-510, manufactured by Datasouth of North Carolina, is an attractive and easy to operate printer with programmable vertical and horizontal tabs. At 180 characters-per-second it is a very cost-effective printer. Another nice feature is the ability to enhance output with double width characters.

The users we contacted were not using the P-510; instead, most had the NEC Spinwriter which, for them, was a sturdy and good quality printer.

USER COMMENTS

- *The NEC is a workhorse.*
- *The 55 cps printer is slow, but we can't afford a faster one. One of the first things we'd change is the slow printer.*
- *The NEC is pretty good.*
- *No problems with the NEC, like the quality.*
- *The NEC does a good job.*

BILLINGS BC-12DF2M: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	BOS (Billings Operating System)
Languages:	BBASIC, EBASIC, FORTRAN, COBOL Macro Assembler
File Access Methods:	Direct, Indexed, and Sequential
Utilities:	The Billings Operating System contains a large number of utilities for system management, file management and control, and program development/maintenance.

OUR OBSERVATIONS

The Billings Operating System consists of a system nucleus, a Command String Interpreter, and various programs and utilities. The system nucleus is automatically loaded into main memory on power-up and is always resident in memory. It is the interface for all input and output.

The Command String Interpreter accepts commands from the user which allow various routines and utilities to be executed. This user/system interface is a standard line-by-line approach (as opposed to a menu-driven approach). To aid the less experienced user, a HELP command is available. HELP may be invoked alone or with a specific command and provides information about the command and its associated parameters.

We were quite impressed with this operating system (it's actually a modified OASIS operating system which we've seen before). It offers features and capabilities more often found on more expensive minicomputers.

We are quite familiar with Billings EBASIC (it's a version of Microsoft's BASIC-80) and found it to be acceptable as always. The users we interviewed were using a variety of languages and generally reported satisfaction. Several people had used the program development tools SCREEN ASIST and PRINTER ASIST and reported only that they worked.

USER COMMENTS

- *No software problems.*
- *BBASIC is great.*
- *I like SCREEN ASIST.*
- *FORTRAN is fine.*
- *There's some good points and drawbacks to BBASIC. I can't control screen output very well.*
- *PRINTER ASIST--it works.*
- *EBASIC is pretty good.*

BILLINGS BC-12DF2M: SOFTWARE COMPONENTS

BILLINGS SUPPLIED PACKAGES

Billings supplies a variety of application packages including:

- Inventory Management
- Legal Accounting
- BOOKKEEPER series which consists of
  - Accounts Receivable
  - Accounts Payable
  - General Ledger
  - Payroll
- Billings Data Manager (a relational data base system)
- Computamatic Terminal (allows the system to become a smart ASCII terminal
- Word/Forms Processor (a screen oriented text processor)
- Letter Processor (designed for mailing lists)
- Document Communicator (to allow the system to send/receive documents to and from another computer)
- Training and Demonstration Programs

OUR OBSERVATIONS

Billings offers an extensive line of application software that is designed and developed by Billings personnel. We had a chance to look at some of the Bookkeeper series of programs and found them to be very easy to use and well-designed. First-time users will find the training and demonstration programs especially helpful in learning how to use the Billings system.

In addition to the packages outlined above, Billings has installed their Energy Management System in several companies. This system is tailored to the purchaser and is sold only by Billings, not through dealers. The price of this package will depend on the configuration.

USER COMMENTS

- *When the word processor works, it's pretty good.*
- *Lots of problems with the legal pack the first six months, support is fine, but they're taking a long time.*
- *So far payroll has worked well for us. Didn't need to be modified.*
- *Word processing is fantastic.*
- *Word processor is excellent. I have yet to find a feature it doesn't have.*
- *As far as they finished the application packages, they were okay. Had to have a programmer finish them.*
- *The packages are just fine and what we want changed, they're changing for us.*
- *You need an 8-inch drive for their packages.*

EDITOR

Under EBASIC, the editor is line oriented with no global change capabilities. Editing is accomplished by typing the command "EDIT" followed by a line number. A series of subcommands are then used to move the cursor, display the lines, and insert, delete, find and replace text.

OUR OBSERVATIONS

To create a BASIC program, lines of code are entered, each beginning with a line number (automatic line numbering is available). Syntax errors are not detected until program execution, and then are found only one at a time as encountered, rather than a summary list of all syntax errors being given. This means that a program will begin execution and continue execution until a syntax error is found or normal termination occurs.

When a syntax error is found, the line is placed in edit mode with the line number displayed. The programmer can then edit the necessary change and re-execute the program. We feel this approach to editing can be very slow and time consuming for the programmer, especially if a syntax error occurs toward the end of a long program. We would much prefer to use either line-by-line syntax checking during program entry, or at least syntax error checking before actual program execution.

One feature we did appreciate is the RENUM facility which allows the user to renumber program lines.

Nearly all the users we contacted in our survey were using application packages developed externally (Billings' or their dealer). For that reason, we have no user comments on the EBASIC editor.

BILLINGS BC-12DF2M: SUPPORT SERVICES

DOCUMENTATION

A number of people had problems with the documentation. It was either too technical, incomplete, or, in the case of application packages, not enough was provided.

MAINTENANCE

Billings' standard warranty covers 120 days after the system is shipped, or as an alternative, 90 days after it is installed.

Most of the users we talked to were overwhelmingly pleased with the service they received; and in this area, Billings dealers are a cut above the average in their support.

TRAINING

Billings provides a Training and Support diskette with a menu that guides a first-time user through diskette handling and making back-up copies. Other training is left to the dealer to provide.

USER COMMENTS

- *They're a small company right in town; they give us the help we need. The worst feature is not enough training.*
- *Best part of the Billings is training and dealer personnel.*
- *We rate the documentation as poor; it's difficult to follow.*
- *Documentation is fine, training was excellent. We ask questions anytime.*
- *Training was so good I haven't used the manuals.*
- *Documentation is a little weak. I couldn't learn the word processor from the manual. Training is very good. Of all the features of the Billings, the one of most value has been the relationship I have with the local dealer.*

SUMMARY OF USER COMMENTS

Using names supplied by Billings Computer Corporation, we contacted sixteen users of the Billings computer. It was being used for utility billing, word processing, law research, math and engineering applications, financial reporting and standard accounting procedures. One firm had owned the Billings for three years though the average was about one year. Several people said they bought the Billings because of the sales personnel and the proximity of the dealer to their company. Other reasons given included price, application software, dealer willingness to modify packages, expandability, and an advanced word processor.

Thirteen users had the BC-12FD which differs from the BC-12DF2M only in its use of 5-inch floppy drives rather than 8-inch drives; and three of the users we spoke to were using the BC-12DF2M as evaluated in this report. The most widely used printer was the 55 cps, letter quality, NEC Spinwriter. Users were very pleased with the Spinwriter, describing it as a "workhorse" with good quality print. However, some users were inconvenienced because it was "slow," and therefore hampered throughput. The keyboard and screen were well liked and trouble free. Users also liked the function keys, green screen (as opposed to those with a grey screen), and the easy to use typewriter keyboard. Three of the sixteen users had data communications linked to the system.

Users' comments made it clear that the outstanding qualities of the Billings computer were the relatively maintenace free hardware and the excellent service. In fact, one user said it was "fantastically reliable." This sentiment was repeated by many others as well. However, there were some problems with static electricity and the drives, but these and most other problems were considered minor or things that "could be expected." Only one person felt Billings hardware service was lacking and was very displeased with them for that reason. Others rated service extremely high.

System capacity was not a drawback for most of the users we interviewed. They frequently stated that within their price range, the Billings' storage capacity was "normal." Many of those with 5¼-inch disk drives were planning on upgrading to the 8-inch disks. Several users said Billings packages were

really written for 8-inch disks and were cumbersome on the smaller ones. Central memory of 56K also did not seriously encumber the users. Some users wished they could get more but said they couldn't afford it. Speed of operation was "very acceptable" according to most users we interviewed. Those that disagreed said it was slow, but they still regarded the Billings as a good system. One of their comments was, "it's worst feature is speed," but "as they upgrade the system, the speed improves."

Five of the users reported that they were doing in-house programming, and all the users had at least one Billings package. These packages were well received and considered valuable because of dealer support and willingness to tailor the packages for the user. A drawback of these programs for two users was that the programs were released too soon, before they were finished and completely error checked. But even these two users were satisfied with the packages and had helped Billings with modifications. The reactions to the word processor were favorable, and in general, it was working well for the seven users with text processing needs. The languages being used included BBASIC, EBASIC, and FORTRAN. Most of the users did not give an evaluation of these languages. A user did say he liked BBASIC but had trouble controlling screen output. SCREEN and PRINTER ASIST were not that widely used. Users said they "worked" but didn't mention special capabilities or drawbacks.

In the area of support services, many of the users we spoke to felt the Billings' documentation was too technical, incomplete, difficult to follow, and gave incorrect information. However, support from dealers through training and program modifications was good. Instruction was generally viewed as "fantastic" or "good," though several users felt it was inadequate. The dealers were regarded as knowledgeable and helpful, and several users thought they were very "accommodating" due to their willingness to train new personnel and upgrade their knowledge.

The Billings computer has proved to be a good system for the users in our survey and they are satisfied with their choice. None expected it to perform like a minicomputer for the price of a microcomputer, and consequently were aware of its limitations, especially with regard to disk capacity and speed. Though displeased with the documentation, users defined Billings' outstanding features as dependable hardware, ease of use, application software, and conscientious representatives providing on-going support.

CONCLUSIONS

The BC-12DF2M evaluated in this report is our seventh in this series. Offered by Billings Computer Division of Independence, Missouri, the BC-12 is based on the Z-80A microprocessor. With the processor, memory, and other boards all mounted in the terminal unit, the BC-12 is a small, lightweight system.

The BC-12DF2M comes with two 8-unit floppy disk drives that can store a total of two megabytes of data. The BC-12 can also be purchased with dual 5¼-inch floppies (630 kilobytes total). Hard disk capability in not available on the BC-12 and, according to Billings personnel, is not contemplated for the future. We feel this is an unfortunate drawback to the BC-12, especially for users who would like their on-line storage capacity to grow with their business.

The Billings Operating System (BOS) is an enhanced and upgraded version of the OASIS operating system by Phase One Systems. Our experience with BOS (and OASIS in the past) was very favorable. We found its features and "feel" to be similar to operating systems found on larger, more expensive machines.

Billings offers a number of languages (FORTRAN, BASIC, COBOL, Assembler) and a variety of application packages. During our benchmark process, we did get a chance to examine some of the Billings languages, program development tools, and packages. All in all, we were quite impressed, though frequently we noted that documentation had a great deal of room for improvement.

The Billings BC-12 users we spoke to in our survey, as a group, did little in-house programming. Their experiences, based on application packages bought from Billings and/or Billings' dealers, were by and large quite favorable. Though few were impressed by the speed of the BC-12 (which correlates with our benchmark timings), nearly all were satisfied with their BC-12 purchase. They singled out for praise its ease of use of the system, the high reliability of the hardware, and especially, the good support received from Billings dealers.

The Billings BC-12DF2M is a relatively new offering in the small business computer market. With a familiar processor and well-designed software, BC-12 users we interviewed were "very, very satisfied."

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

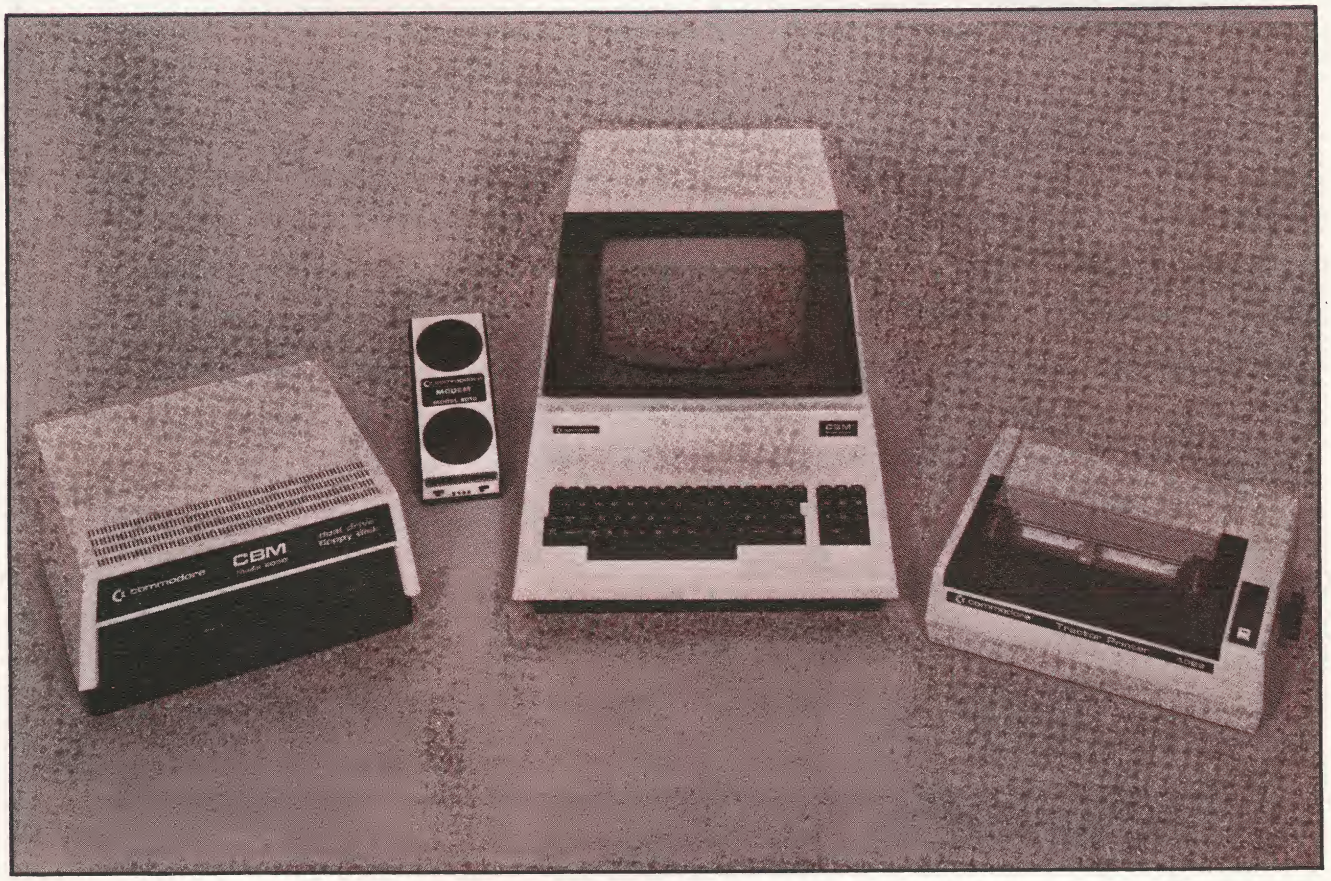
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 9, DECEMBER 1981



In This Issue:

The COMMODORE CBM 8032

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

COMMODORE CBM 8032: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: CBM 8032	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

This is our eighth report in the Continuation of Series 1 and 2 on systems costing under $25,000 and designed primarily for single users. In it we evaluate Commodore Business Machine's CBM 8032 which cost, as tested, $4,085.

The heart of these reports is the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. The results of these benchmark runs provide comparative information which is simply unavailable from any other independent source. The benchmark programs themselves have been designed to run without change on most small computer systems. Thus, differences in performance among systems can be attributed to differences in computing capabilities.

In addition to the benchmark results, these reports contain information on the alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on the ease of use of the system. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report. The experiences of users add a dimension of reality to the technical details of the system.

Information provided by manufacturers can often be difficult to interpret and sometimes misleading. While some of the potential buyers of microcomputers have some background with computers, the majority we've surveyed are buying their first computer, and often the personnel using it will not have had much direct experience with computers. We feel these reports are invaluable to experienced and inexperienced users alike by providing an unbiased assessment of some of the microcomputer systems on the market today. Our results, which are comparable across computer systems, and our observations of the system in a "real world" setting can help potential users intelligently select a system that is best for them.

EXECUTIVE SUMMARY

The Commodore CBM 8032, priced at $4,085 as tested, consisted of a video display and keyboard, a 6502 microprocessor, 32 kilobytes of main memory, CBM 8050 dual 5¼-inch floppy disk drives (one megabyte total), CBM 4022 65 characters-per-second printer, and Commodore BASIC, Version 4.0. The 8032 alone, without drives or printer, is priced at only $1,495.

- The Commodore is the lowest priced system we've examined to date. Though the system cannot be expanded at present in terms of hard disk or multi-user capability, several 8032's can be purchased for the same price as other larger, expandable systems.

- The Commodore 8032 could be described as a "BASIC" machine, or one without the usual operating system/BASIC mode dichotomy. When the system is started, the machine is in "BASIC mode" where programs can be entered, loaded from disk, modified, or run. There is no operating system language but rather all system commands are part of the BASIC language. With this structure the operating system is "hidden," and we found it to be rudimentary, with poor user/system interface.

- The users we interviewed were in general, quite pleased with their CBM system. Nearly all agreed that the price was great and that the documentation left room for improvement. Over half the users had purchased application programs while the rest had written their own or modified off-the-shelf packages. Also, there was nearly unanimous approval expressed for their CBM dealer.

- We found the Commodore version of BASIC to be at best, average. Without the usual enhancements found in most BASIC's (like structured statements, PRINT USING to the terminal, etc.), we feel the 8032 is more awkward to program than other systems we've evaluated. The users we spoke to in our survey did not, for the most part, share our discontent with the Commodore's BASIC. In general, they felt it was fine for their purposes.

- We were in agreement with the users' evaluation of Commodore's documentation . . . in a word, terrible. The one manual provided to us that is produced by Commodore, the BASIC User's Reference Manual, is adequate as a reference, but falls short for anyone not familiar with the CBM system. Books written and published by independent sources do help to fill the information gap, most notably Osborne's PET/CBM Personal Computer Guide.

Commodore's original offering in the computer marketplace, the PET personal computer, has evolved into the CBM 8000 series which is intended for business use. If, like the users we spoke to, the 8032 is purchased from a good dealer with developed application packages, the outstanding price could make the 8032 a contender for your data processing dollars.

BENCHMARK REPORT

SYSTEM: COMMODORE CBM 8032

PRICE AS TESTED: $4,085

SPEED TESTS

Benchmark Number		TOTAL TIME Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500	1	22.0
A-2	N = 1000	2	42.2
A-3	N = 2000	5	22.6
A-4	N = 3000	8	2.8
A-5	N = 500		19.0
A-6	N = 1000		35.9
A-7	N = 2000	1	10.0
A-8	N = 3000	1	43.8
	I/O INTENSIVE		
B-1	N = 500		57.8
B-2	N = 1000	1	7.8
B-3	N = 2000	1	27.5
B-4	N = 3000	1	47.1

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	23	45.1
C-1A		8	35.7
C-2	NEW PRODUCT PLANNING		20.0
C-2A		2	36.0
C-3	ACCOUNTS RECEIVABLE	3	36.0
C-3A		8	47.0

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	250
E-2	SUBJECTIVE JUDGMENT	Easy

THE BENCHMARK PROCESS

The Commodore CBM 8032 used in our benchmark tests consisted of a CRT and keyboard, 32 kilobytes of main memory, dual 5¼-inch floppy disk drives (one megabyte total), and a 65 character-per-second dot matrix printer. The benchmark programs were run in Commodore BASIC, Version 4.0. The system was delivered to our offices in Boulder, Colorado, from a local Commodore dealer.

The 8032 is a "BASIC" machine, or one that does not have the usual operating system interface with its own job control language (JCL). When a user starts up the 8032, the machine is in "BASIC mode" where programs can be entered, loaded from disk, modified, or run. There is no JCL per se, but rather all system commands, etc., are part of the Commodore's BASIC language.

Though this type of BASIC machine is not uncommon (we've seen it on other machines), we felt that the human/system interface was, at best, weak. The few utilities that are available (which are really BASIC commands) provide the user with no information on the status of the utility during its operation or after it is completed. In fact, if the user wishes to ascertain the status of the procedure, output error messages, and/or prompt for input parameters, the user must write a program "around" these utilities. This method does indeed give the user a great deal of flexibility, but we feel it puts a great burden on the user--a burden that should be handled by the operating system (that's what it is there for).

This same type of problem occurs if the user writes an application program. All errors (except syntax errors) must be trapped by the user with a routine that will then print out the short system error message associated with the error. As we entered, modified, and tested our benchmark programs, we found this procedure to be awkward and time consuming (there is not even an ON ERROR statement to ease the problem).

To compound this situation, the Commodore documentation was lacking, to say the least. We were given a single manual published by Commodore which was the BASIC User's Reference Manual. As a reference manual this would be adequate, though there are not nearly enough examples, and the peculiarities of the Commodore system are barely addressed. This manual is clearly intended for someone who is already familiar with the CBM system. Additional help is

available from other sources. Of note is the book written by A. Osborne and C. S. Donahue entitled PET/CBM Personal Computer Guide. This book is extremely useful (in fact, it could be considered required reading for new Commodore programmers), though poorly organized and indexed.

Commodore's BASIC is an "average" BASIC in our opinion. We felt that it was lacking a number of enhancements found in nearly all well regarded business BASIC's. In addition to the poor error handling as noted above, features of particular consequence that are missing include any kind of structured statements (like IF ... THEN ... ELSE or WHILE/NEXT) and a "usable" PRINT USING. The PRINT USING that is available can only be used for output to the printer, and then in a rather awkward fashion. To format a line of output to the printer, the user must open two channels to the printer, outputting the data to one channel with a print statement, and the format to another with a print statement.

To be fair, we must admit that once we got used to the awkward manner of programming the Commodore, we could see that it could be programmed to perform many useful tasks. The memory-mapped video screen with its graphics capabilities is an especially nice feature, as is the editor with its "full screen-like" features.

The benchmark programs were entered, edited, and stored on disk. To execute, they were loaded into memory, the RUN statement was typed in, and the stopwatch started when the carriage return was pressed. Timing was stopped when output was complete and the program terminated.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TEST: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500	1 minute	22.0 seconds
A - 2		N = 1000	2 minutes	42.2 seconds
A - 3		N = 2000	5 minutes	22.6 seconds
A - 4		N = 3000	8 minutes	2.8 seconds

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations on the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500		19.0 seconds
A - 6		N = 1000		35.9 seconds
A - 7		N = 2000	1 minute	10.0 seconds
A - 8		N = 3000	1 minute	43.8 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disks and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500		57.8 seconds
B - 2		N = 1000	1 minute	7.8 seconds
B - 3		N = 2000	1 minute	27.5 seconds
B - 4		N = 3000	1 minute	47.1 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$
$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$
$$\vdots \qquad \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	23 minutes 45.1 seconds

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results:	8 minutes 35.7 seconds

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

C - 2	Results:	20.0 seconds

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	2 minutes	36.0 seconds

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results:	3 minutes	36.0 seconds

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results:	8 minutes	47.0 seconds

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 250 keystrokes were required to edit the nine-line test file.

Comment: Though the number of keystrokes required for this edit test is high, we would rate the Commodore's BASIC editor quite highly. The cursor can be moved anywhere on the screen where characters can be inserted or deleted.

COMMODORE CBM 8032: PRICING COMPONENTS

COST

CBM 8032, as tested $4,085

Includes:
- Video display CRT
- 32 kilobytes central memory
- Attached typewriter keyboard
- BASIC, Version 4.0
- CBM 8050 dual 5¼-inch floppy disk drives (1 megabyte total)
- CBM 4022 65 characters-per-second printer

Components

- CBM 8032 (with BASIC) $1,495
- CMB 8050 dual disk drives $1,795
- CBM 4022 printer ..... $ 795
- Expansion

  64K add-on memory ..... $ 500

OUR OBSERVATIONS

The 8032 is the lowest priced system we have evaluated to date. At the present time, no hard disk or multi-user upgrades are available. The lack of expansion capability is often viewed as a drawback for a system, though with the Commodore, a user could purchase several more complete 8032's for roughly the same price as other expandable microcomputers.

Most of the users we talked to felt that the Commodore was an excellent buy and had purchased it primarily because of the price. Commodore offers schools the option of buying three 8032's for the price of two, not including peripherals.

USER COMMENTS

- *I'm totally pleased with the system; for the money I think it's the best.*
- *Overall, I think it's an excellent machine and particularly well suited for a small office.*
- *Number one feature is price.*
- *The hardware is 100 percent reliable.*
- *The hardware is reliable, durable and very compact--no wires or cables running everywhere.*
- *Overall, it's an excellent system; we've got five more ordered.*
- *We had an amazing number of hardware problems, but now that we're up and running the hardware is okay.*

COMMODORE CBM 8032: HARDWARE COMPONENTS

CENTRAL UNIT	The 8032 is contained in a single unit that includes the keyboard and CRT. The unit is 14" x 16.5" x 18.5" and weighs 50 pounds.
CPU Memory:	The standard amount of random access memory is 32K and is upgradeable to a total of 96K. All of the 32K RAM is available to the programmer.
CRT/Keyboard:	The CRT can display 2,000 characters in 25 lines and 80 columns on a green phosphor screen. Commodore uses its own character set that includes all standard ASCII characters and 64 graphics characters. The keyboard has 73 keys with repeating capabilities and graphics mode characters.

OUR OBSERVATIONS

The Commodore CBM computer uses the 6502 processor manufactured by MOS Technology, Inc. The system we tested had 32 kilobytes of Random Access Memory (RAM), all of which is available to the user. This is accomplished through the use of Read Only Memory (ROM) to store Commodore's operating system and BASIC interpreter and a special 2K area for input/output buffers and the memory-mapped video display.

The users we interviewed were pleased with the green phosphor screen and the keyboard. A drawback of the 10-key numeric pad for some was that there was no enter key near the pad.

USER COMMENTS

- *The worst part is the limitation of the 32K central memory.*
- *So far 32K is plenty because we're doing a lot of disk accessing.*
- *32K is not enough for WordPro 4-plus.*
- *It's super fast.*
- *The green screen is easy on the eyes. Numeric key pad could be laid out better, there's no enter key on it.*
- *The keyboard is excellent. I'd like the screen to be movable.*
- *The screen has good resolution. I'm a little worried about the keyboard--they have trouble after awhile.*
- *I would like to see more control functions, especially for word processing.*

COMMODORE CBM 8032: HARDWARE COMPONENTS

STORAGE

The CBM 8050 drive unit has two single-sided drives for 5¼" floppy diskettes. Each diskette holds 509 kilobytes of characters in a soft sectored format. The unit is 7-1/8" x 15" by 15½" and weighs 28 pounds.

There are drive activity indicator lights with a red light that signals errors. This will go on during incorrect file accessing and hardware malfunctions.

OUR OBSERVATIONS

We had trouble backing up a diskette and were not able to tell if it was caused by the hardware or software. A new diskette is formatted by the HEADER command where a user must assign the diskette a name and number.

Around the first of December 1981, Commodore will market the 80250, dual double-sided, double-density drives, which will provide two megabytes of on-line storage. Shortly after that, a 10 megabyte hard disk will also be available. The majority of the users' storage needs were well met with one megabyte of on-line storage.

USER COMMENTS

- *I have Apples and the Commodore. I'm switching more and more to the Commodore because of ease of use, readable screen, and disk storage.*
- *One megabyte is one thing we might need to upgrade.*
- *One megabyte is more than enough. I've got 950 accounts on one set of disks.*
- *I can see a need for more than one megabyte in the future.*
- *With 500K per disk, we've got scads of room left.*

OTHER DEVICES

Printers: CBM 4022 - 65 characters-per-second
unidirectional, dot matrix
80 columns, tractor feed
variable line spacing
prints graphics characters
paper width up to 10 inches

CBM 8023P - 150 characters-per-second, bidirectional

CBM 8300P - 40 characters-per-second, letter quality
daisy wheel

Communications: CBM 8010 Modem - full/half duplex, 300 baud

Cassette Record/Player: CBM C2N - 250 baud, 100% redundancy check

OUR OBSERVATIONS

Users felt that the 4022, manufactured by Epson, was adequate for the price. Some limitations mentioned about Commodore printers were that they were not bidirectional, the feed mechanisms slipped, and as logical devices, they were hard to access easily with the software. We have to agree with some of their comments. We had frequent trouble with the paper going out of alignment, with the end result of a torn and wrinkled copy. As far as getting printer output, we also concur with the user who said it required too many "magical commands that didn't seem necessary." It requires a total of three statements to open and close the printer device.

Some of the users had communications linked to their 8032's and generally, these communications applications were working well. A problem in this area was that the Commodore used a non-ASCII character set, therefore making a conversion interface necessary.

USER COMMENTS

- *For the price, the 2044 is not bad, we have trouble with the tractor feed mechanism.*
- *I don't like the 4022 printer that well; the letter image for word processing isn't that good.*
- *The 4022 printer is adequate; with the software it's hard to get running.*
- *For the money, the 4022 printers are fine.*
- *Printing is cumbersome, you have to use too many magical commands that don't seem necessary.*

COMMODORE 8032: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	Commodore DOS 2.0
Languages:	Commodore BASIC Version 4.0, Assembly
Utilities:	The Commodore 8032 has file management utilities including DIRECTORY, BACKUP, and APPEND.

OUR OBSERVATIONS

The Commodore 8032 could be described as a "BASIC" machine, or one without the common operating system/BASIC mode dichotomy. When the system is booted up, the user is placed in the BASIC interpretive mode. At this point, the user may enter a new program and execute it, load an old program, or enter a BASIC statement without a line number to be executed immediately (immediate mode). Thus, all utilities, etc., are either Commodore BASIC statements, or BASIC programs written by the user.

We found Commodore BASIC to be an "average" BASIC. It has few of the enhancements found in many other BASIC's (including structured statements and PRINT USING) and we feel the disk I/O procedures are especially cumbersome. Particularly awkward, in our opinion, is the fact that the user must trap for all disk I/O errors and print the rather uninformative error message rather than this being handled by the system.

The users we spoke to in our survey did not, for the most part, share our discontent with Commodore's BASIC. In general, they felt that it was fine for their purposes.

USER COMMENTS

- *BASIC is all right.*
- *Commodore's BASIC is fine. People are learning from it.*
- *I would like BASIC better if it had things like PRINT USING.*
- *The BASIC is good ... we've never used anything else.*

COMMODORE SUPPLIED PACKAGES

- OZZ - data base management
- IRMA - data base management
- Legal Time Accounting
- Wordcraft 80 - word processing
- Medical package (soon to be available)

OUR OBSERVATIONS

We did not look at Commodore's application packages and none of the users had any of the above except Wordcraft and were satisfied with its text processing capabilities. The other word processing program in wide use was WordPro 4-Plus, developed by Professional Software in Massachusetts.

USER COMMENTS

- *We're quite happy with the Commodore, especially the price and the accounting package.*
- *The software that is available is legion, but if I were a business I don't think I'd be as thrilled with the software.*
- *The Commodore took the place of a CPA doing quarterly reports. Now I get the same report with general ledger.*
- *I like Wordcraft.*
- *WordPro 4-Plus is excellent. I'm very, very happy with it. I would say that for what you need to do and what the documentation says to do are two different things.*
- *Software available for the Commodore isn't that good; I usually have to rewrite it.*

COMMODORE CBM 8032: SOFTWARE COMPONENTS

EDITOR

With a memory-mapped screen and full cursor control, editing programs on the CBM 8032 consists of:

- To delete a line, enter the line number.
- To enter a line, enter the line number and the program statement.
- To modify a line, enter the line number and retype the line, or display the line on the screen, move the cursor to that line, use the cursor control keys to move within the line, use the delete and insert keys to add or eliminate characters, hit return to enter the modifications.
- To repeat the same statement several places in the program, display the line, modify the line number, enter return.

OUR OBSERVATIONS

We found the Commodore's editing features to be very easy to use and we enjoyed the screen oriented nature of the system. Though not what we would describe as a "true" screen-oriented editor (there is no paging, global search and replace, etc.), it has many features similar to that of a screen-oriented editor. If a line is displayed on the 8032's screen, the user can move the cursor directly to that line and make changes. When the return key is depressed, the change is entered and the cursor may then be moved to any other line that is currently displayed and further changes may be made. A LIST command is available to display lines on the screen.

While the Commodore editor required more keystrokes (250) on our editing test than any other system we've evaluated, we would still rank it as one of the easier we've used. One reason for this is that though the editing keys will automatically repeat when held down, our test requires that we count each discrete cursor movement as a separate keystroke. The users we spoke to in our survey were also pleased with the Commodore's editing features.

USER COMMENTS

- *It has excellent editing facilities.*
- *The editing functions are nice.*
- *We don't use the editor; we have program development software.*
- *Version 4.0 of BASIC has a lot of built-in features such as repeating a line. The freedom of movement of the cursor is nice.*

DOCUMENTATION

The manual we used that was actually produced by Commodore was the User's Reference Manual for BASIC, Version 4.0. In effect, this book is all that Commodore provides for programming and operating their computer. The other reference book most widely used with CBM systems is Pet/CBM Personal Computer Guide, published by Osborne/McGraw-Hill. This book is not well organized and a user must find his answers by constantly cross-referencing within the text. This is made more difficult because the book lacks a concise index. With all the peculiarities of the 8032, Commodore falls far short of supporting the users of their systems.

Most of the users agreed with each other about their assessment of the available documentation for Commodore systems and were emphatic about the quality--they said it was terrible. We have to agree. Basically, the documentation is incomplete, poorly organized for use as a reference, and is a very weak resource for a novice computer user.

MAINTENANCE

There is a 90-day standard warranty with separate maintenance contracts supplied by dealers.

TRAINING

Dealers are responsible for giving instruction on both hardware and software useage. There is a Commodore hot-line that also provides assistance to users. The users felt their Commodore dealers were knowledgeable and helpful, although several expressed the opinion that Commodore did not support their dealers.

USER COMMENTS

- *The biggest problem is the terrible documentation and Commodore's terrible relationship with their dealers. It's a miracle they're still in business.*
- *Commodore has the worst documentation that exists on the face of the earth and there's universal agreement.*
- *The documentation is not that bad; it's typical for the industry.*
- *Training was not the greatest, it could have been better.*
- *I don't like the documentation. It's not clear and doesn't have enough examples. If you're a novice, forget it.*
- *The documentation is adequate; it's like any technical document. I'm beginning to understand it. You just can't pick it up and use it.*
- *Service from our dealer is excellent. Service from Commodore was hopeless up until recently. The biggest problem is trying to get information from them.*
- *We've gotten really fine service. Problem is getting parts. Commodore doesn't seem to support their dealers very well.*

SUMMARY OF USER COMMENTS

Using names supplied by Commodore Business Machines, we interviewed fourteen users of the Commodore CBM 8032. These companies had owned the 8032 from three months to one and a half years with the average length of time about seven months. On the average, it was being used about four hours a day, five days a week for a wide array of applications. Several science labs were using it to maintain and access data bases, a police department was using it for crime analysis and suspect files, some businesses were using it for their accounting needs and three schools were teaching computer science with the 8032's. Six firms were using it for word processing. The schools and one large company owned from three to nine systems.

The hardware configuration varied only with the type of printer in use and only six firms used Commodore printers. A general comment about the 4022's was that for the price, they performed adequately. However, drawbacks mentioned were that it was not bidirectional and the image quality of the characters was not suitable for word processing. Users liked the keyboard and said it was functional and durable, although several users said they didn't think the keyboards lasted well and had to be replaced. The green phosphor screen was liked for its high resolution and readability.

Users were almost equally divided on whether or not 32K of RAM was limiting. Users of WordPro 4-Plus and Assembly had the biggest problem with this amount, and said 32K was just not enough. Some users expressed a desire to upgrade it but were cautious about the 96K expansion and felt there might be some incompatibility with their programs. Disk storage space was sufficient for most of the users, but three users said it wasn't enough and expected to increase their storage. System speed was viewed as adequate, fine or slow. Users felt applications with a lot of disk I/O slowed it down the most. Overall, the hardware was described as reliable, although one user said he had "an amazing number of problems," but it seemed to be working well now.

All but three of the users were doing at least some programming. They felt Commodore's BASIC was fine. One user, though, said he would like it better if it had a "print using" capability. The editing facilities were equally

well liked, especially for the freedom of movement of the cursor and the ability to easily repeat lines by changing the line numbers. Three were programming in Assembly and felt it could be improved.

Most application programs purchased by the businesses from third party software houses were working quite well. Five users had WordPro 4-Plus which they liked. Some of its shortcomings were that tab locations couldn't be stored on the disk, it couldn't print out more than 15 pages without locking up and the documentation was contradictory. Negative comments about other software were that it had to be rewritten, or that it wasn't completely suitable for business applications.

Both software and hardware dealer support were rated very high by almost everyone. In fact, some mentioned buying the Commodore because of their local dealer's expertise. "I like the service, I bought it because my dealer is very knowledgeable. I don't think it would be a very good system if I didn't have him to help me." Users also felt Commodore did not support their dealers very well, especially in obtaining parts for them. Others said Commodore was not supportive of the end user and said they had trouble getting information about system capabilities. Users rated their training as "not the greatest," "adequate," and "excellent."

System speed was not a problem, the hardware was reliable, the price was outstanding, nearly everyone loved their dealer, storage size was adequate, third-party programs were running well--was there anything these users didn't like about the Commodore? "Commodore's documentation is terrible, it's the worst documentation that exists on the face of the earth and there's universal agreement!" In this case half the users didn't agree, but they were also the people who were either doing none at all, or very little, in-house programming. Specific criticisms were that it was poorly organized, lacked examples, was hard to use as a reference and was not suitable for novice users.

Users liked different aspects of the CBM 8032, everyone liked the price, and almost everyone felt the documentation was either a serious shortcoming or, at least, left room for improvement. All things taken into consideration, these users were very happy with the CBM 8032.

CONCLUSIONS

As a "BASIC" machine, the CBM 8032 does not have an operating system language or job control language (JCL) and a separate programming language(s). Instead, all system commands, etc., are part of the BASIC programming language. Though this type of system can greatly increase the user's flexibility, we feel, in this case, it places an undue burden on the user. In order to increase the "friendliness" of the system utilities (e.g., add user prompts, check for errors, report on status, etc.), the user must write programs "around" the BASIC command.

We found Commodore's BASIC to be an average version of BASIC with few of the enhancements found in many other BASIC's we've examined. We were quite favorably impressed with the 8032's editing features. Using a memory-mapped screen and full cursor control, this line-oriented editor seems like a full screen editor. Of the users we spoke to, those who were doing some in-house programming did not share our discontent with the Commodore's BASIC. In general, they felt it was fine for their purposes.

Though not expandable in terms of multi-user or hard disk capability, the Commdore CBM 8032 is the lowest priced system we've tested to date ($4,085 with dual floppies and printer, $1,495 for the computer alone). With this low price, users can often afford to buy more than one system and still spend less than for other expandable systems.

The users we interviewed were basically quite pleased with their Commodore system. Quoting price as their favorite feature, and documentation as their least favorite (we agree), these users were happy with the 8032's performance and especially pleased with their dealers.

In 1977, Commodore Business Machines released the first system in the CBM series, the PET 2001 (Personal Electronic Translator). Intended primarily as a personal computer, this system has evolved into the CBM 8032 evaluated in this report. With its "roots" in the personal computer or hobby market, the Commodore CBM 8032 is now competing in the small business computer market. With its low price, and when combined with good dealer-supported applications (word processing is especially popular), the 8032 should provide some tough competition in the years ahead.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

commodore

300 Valley Forge Square
681 Moore Road
King of Prussia, PA 19406
215-337-7100

December 30, 1981

Mr. Hillel Segal
Association of Computer Users
4800 Riverbend Road
P. O. Box 9003
Boulder, Colorado 80301

JAN 0 8 1982
ACU

Dear Hillel:

Thank you for the copies of the recent benchmark report on Commodore. There are several points that may be of interest to your readers raised by comments in this report:

1) We do in fact include the standard documentation with our products - the McGraw Hill PET Personal Computer Guide, which we believe is an excellent book on the product. Because it is published under McGraw Hill's name, your reviewer probably did not realize that this is in fact given out by Commodore.

2) For your information, we have just announced a 6.5 and 9.5 megabyte hard disks for the 8032, which is scheduled for production during the first quarter of 1982.

3) One feature that we have found our users delighted with are the editing features included on our machines which makes it easier for programming. This did not appear to get much mention in the report.

Kind regards.

Sincerely,

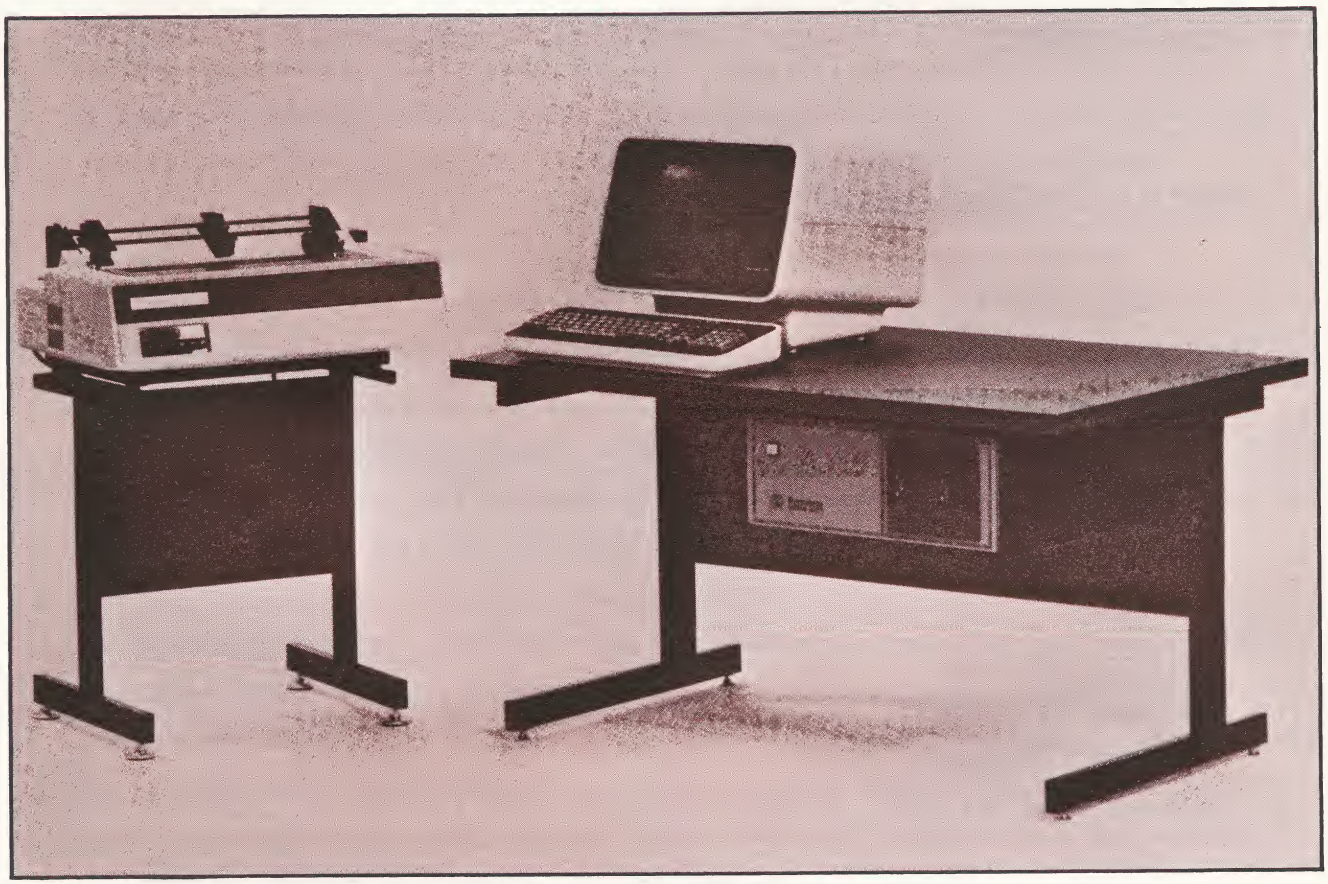
Christopher Spencer
Vice President - Marketing

Enclosures

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 10, DECEMBER 1981



In This Issue:

The SMOKE SIGNAL Chieftain

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

SMOKE SIGNAL CHIEFTAIN: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: Chieftain	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

Smoke Signal Broadcasting's Chieftain is the ninth small computer system to be evaluated in this series of reports covering single-user systems costing under $25,000. Following the trend in small system design, the Chieftain is capable of multi-user/multi-tasking applications, though we tested it only in its single-user configuration.

We have noted, both with excitement and apprehension, the growing number and variety of small systems. With excitement, because the competition is giving users capabilities and prices undreamed of a few years ago. With apprehension, because the variety can be bewildering. However, the greater choice of systems and options means you can find a computer which meets business needs, rather than trying to fit the business to the demands of the computer.

Because of the potential "pitfalls" in purchasing a computer system, it is to everyone's benefit to learn as much about computers as possible, even in light of the trend toward user-oriented and turnkey systems. From our user surveys, we've found that overall, the most satisfied end-users are those who are most knowledgeable about computers. They know the limitations of a small computer system and consequently have the most realistic expectations of what a computer will do for their business.

Our benchmark reports continue to be a valuable resource for sifting through the often subtle differences among small computer systems. These reports provide the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. Additional information is given on the alternative configuration which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on ease of use. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report.

EXECUTIVE SUMMARY

The Smoke Signal Broadcasting Chieftain (Model 9822) provides a greal deal of capability and versatility at just over $8000. The system we tested had 56 kilobytes of memory, the 6809 microprocessor, an Anadex printer, a Sorce IQ 120 CRT/keyboard, and a dual 8-inch drive providing a total of 2 megabytes of storage capacity. We also tested the 98W10 which is the same system with a 10 megabyte hard disk.

- The Chieftain is marketed principally through software houses providing application programs as well as the hardware. It is based on the 6809 microprocessor which is a 16-bit processor with an 8-bit data bus (or what could be described as an enhanced 8-bit microprocessor).
- One of the major advantages of the Chieftain is its multi-tasking/ multi-user capability. A single user can have several tasks (jobs) executing simultaneously, and several users can be using the system simultaneously.
- The OS-9 operating system, incorporating a number of UNIX-like concepts (UNIX is an operating system developed by Bell Laboratories), was designed to take advantage of many of the unique programming features of the 6809.
- BASIC-09 follows the trend of many languages in being an enhanced version, including structured flow-of-control statements (like IF . . . THEN . . . ELSE, etc.), as well as a Pascal-like TYPE statement which allows the creation of complex data structures.
- Of the systems we have tested in this series, the Chieftain is among the fastest in CPU and I/O speeds.
- Users were happy with the reliability of the system. Also, they remarked that the OS-9 operating system and BASIC-09 were excellent.
- Users did express dissatisfaction with software availability, and with documentation. While Smoke Signal's Information Exchange seems to list a number of applications, either users were not made aware of the availability, or they found the software unsuitable. Documentation was mimeographed, and was oriented toward the more technical user.

As the ninth system we have tested in this series, we spent additional time studying the Chieftain because of the unique nature of the 6809 microprocessor and the OS-9 operating system. We liked the versatility of the UNIX-based operating system, and the BASIC language provided by Microware. For those doing programming in-house, the Chieftain and the multi-user capabilities of the OS-9 are an attractive combination. Our only reservation at this point is the apparent lack of turnkey software, and the potential purchaser should carefully check the applicability of the dealer's offering.

BENCHMARK REPORT

SYSTEM: SMOKE SIGNAL CHIEFTAIN
PRICE AS TESTED: $8,149

SPEED TESTS

Benchmark Number		TOTAL TIME* Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500		19.0
A-2	N = 1000		34.6
A-3	N = 2000	1	6.2
A-4	N = 3000	1	37.4
A-5	N = 500		5.4
A-6	N = 1000		7.4
A-7	N = 2000		11.7
A-8	N = 3000		15.8
	I/O INTENSIVE		
B-1	N = 500	1	26.9
B-2	N = 1000	1	33.7
B-3	N = 2000	1	51.9
B-4	N = 3000	2	10.2

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME* Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	3	13.3
C-1A		1	9.5
C-2	NEW PRODUCT PLANNING		5.7
C-2A			43.9
C-3	ACCOUNTS RECEIVABLE	1	40.7
C-3A		3	3.4

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	177
E-2	SUBJECTIVE JUDGMENT	Very Easy

*Note: For the hard disk times, see pages 9 through 12.

THE BENCHMARK PROCESS

All benchmarks were run using the OS-9 operating system and BASIC-09, written by Microware for the 6809 microprocessor used in the Chieftain 9822 system. This system contained 56 kilobytes of main memory, dual 8-inch floppy disk drives (each holding 1 megabyte of data), a Soroc IQ 120 CRT terminal with keyboard, and an Anadex 9500 printer. We also ran the programs on the Chieftain 98W10 configuration which consists of the same CPU but replaces the dual floppy drives with a single floppy drive and a 10-megabyte Winchester hard disk.

The components were shipped to our offices in Boulder, Colorado. They were connected and the floppy system was immediately operational. A loose connection on the hard disk was fixed and that system also became operational.

The OS-9 operating system is based on the UNIX approach to operating systems (UNIX was developed by Bell Laboratories for larger systems, and has had relatively wide use). There are four key features to this system as implemented on the Chieftain. First, files can be stored in a hierarchical directory fashion (or tree structure). Thus, a user's file directory can have subdirectories, which may consist of additional subdirectories, etc. As a result, files for different tasks or applications can be separated into different subdirectories.

Second, all input/output activities are handled as if they were files, and a separate "device driver" transforms the data to the correct format for the device. Thus, a program does not have to have devices assigned until run-time, and I/O can easily be redirected at any time.

The third feature is that multi-tasking and multi-user operations are designed into the OS-9 operating system. Multi-tasking means that a single user can start a job (such as a listing on the printer), and can begin a second job while the first is still running. The system automatically allocates "time slices" to both tasks. The multi-user capability means that several terminals can be connected and running at the same time. The system provides log-on and password capabilities, providing system security from unauthorized use.

Finally, programs and utilities are "re-entrant." This means that several users can each be running the same program, and there need only be a single copy of the program in memory. This feature, though not unique to OS-9 and the 6809 microprocessor, is relatively simple to implement because of the design characteristics of the 6809.

BASIC 09 provides line-by-line syntax checking as programs are entered. The edit mode is entered and each line is typed. Line numbers are not required unless a statement is the target of a branch. The editor is essentially line-oriented, though you can search for and replace strings. When a program is executed it is first compiled into a very compressed internal code (nearly machine language) and executed by a run-time interpreter.

Some of the features of BASIC 09 are:

- A debug mode, entered on program errors or PAUSE statements, which allows single stepping, tracing of computations, listing and changing variable values, etc.
- Structured programming statements such as IF . . . THEN . . . ELSE, WHILE . . . DO, REPEAT . . . UNTIL, and LOOP.
- Easy access to the system from within a program, so the program can directly execute system routines like file copy, directory listings, etc.
- The ability to define new variable types (other than integer, real, and string). This capability is a subset of the type definition in Pascal, and can be used to define complex arrays, records, etc.
- Formatted output using FORTRAN-like field specifications in conjunction with a PRINT USING statement.

All programs were run with output to the CRT. Routing output to the printer required a change in the OPEN statement. The programs were first entered and stored on disk. For execution, programs were loaded into memory, the RUN statement typed in, and the stopwatch started when the carriage return was pressed. Timing was stopped when output was complete.

OVERVIEW OF PROGRAMS AND RESULTS

The benchmark program set consisted of:

Speed Tests

- A CPU-Intensive job of varying parameters
- An I/O-Intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500	19.0 seconds
A - 2		N = 1000	34.6 seconds
A - 3		N = 2000	1 minute 6.2 seconds
A - 4		N = 3000	1 minute 37.4 seconds

Comment: This program does not use the hard disk.

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500	5.4 seconds
A - 6		N = 1000	7.4 seconds
A - 7		N = 2000	11.7 seconds
A - 8		N = 3000	15.8 seconds

Comment: This program does not use the hard disk.

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disk and then hard disk and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500	1 minute 26.9 seconds
B - 2		N = 1000	1 minute 33.7 seconds
B - 3		N = 2000	1 minute 51.9 seconds
B - 4		N = 3000	2 minutes 10.2 seconds

Comment: For the hard disk these times were 19.9, 23.2, 29.4, and 35.9 seconds, respectively.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$

$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$

$$\vdots \qquad \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results: 3 minutes 13.3 seconds

Comment: This program does not use the hard disk.

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results: 1 minute 9.5 seconds

Comment: This program does not use the hard disk.

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

C - 2	Results: 5.7 seconds

Comment: This program does not use the hard disk.

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results: 43.9 seconds

Comment: This program does not use the hard disk.

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results: 1 minute 40.7 seconds

Comment: For the hard disk, this time was 35.2 seconds.

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results: 3 minutes 3.5 seconds

Comment: For the hard disk, this time was 1 minute, 59.5 seconds.

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a nine-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 177 keystrokes were required to edit the nine-line test file.

Comment: We found the Chieftain's line-editor very easy to use.

SMOKE SIGNAL CHIEFTAIN: PRICING COMPONENTS

COST

Smoke Signal Chieftain

Model 9822 with dual floppy, as tested ..... $ 8,149
Model 98W10 with single floppy and hard disk, as tested $12,169

Includes:
- 56 kilobytes of memory
- Soroc IQ 120 terminal
- Anadex Model 9500 printer
- OS-9 operating system
- BASIC-09

Components:

- Series 9000 computer system based on the 6809 microprocessor chip, and 32 kilobytes of memory

  Model 9822 with dual floppy ..... $ 4,675

  Model 98W10 with single floppy and 10 megabyte hard disk 8,695

- Additional 24 kilobytes of memory 439
- Soroc IQ 120 CRT terminal 995
- Anadex Model 9500 printer 1,650
- OS-9 Operating System 195
- BASIC-09 195

OUR OBSERVATIONS

The price on the Chieftain includes Smoke Signal's own DOS (disk operating system) which is a traditional single-user system. We used the OS-9 system and BASIC in our benchmark tests. Because it is multi-user/multi-tasking, we would recommend it given the slight additional cost.

USER COMMENTS

- *I bought it because it was reasonably obvious that it was the best around. Operating system is reliable and the system turned out to be the least expensive. Best feature of the Smoke Signal is its reliability, it just sits there and works. A drawback is the lack of an extremely large software base. Overall, it's very good.*
- *No hardware problems, and that's quite a thing to say. Sometimes we run out of memory at 56K. Speed is okay. I think it's an excellent computer. I like the cabinet, and the reliability of the hardware and software.*

SMOKE SIGNAL CHIEFTAIN: HARDWARE COMPONENTS

CENTRAL UNIT .... The Chieftain system is contained in two units which easily stack on a desk. The first unit contains the central processor, memory, disk controller, and input/output circuits. The second unit contains the dual floppy drives (or the single floppy/hard disk combination). The system is based on the powerful Motorola 6809 microprocessor.

CPU Memory: The unit comes with 32 kilobytes of memory. We used a system with 56K, and the unit can be expanded to 224 kilobytes.

Keyboard/Screen: Any standard terminal can be used. We were shipped the Soroc IQ 120 which has upper/lower case, cursor addressing, protected/unprotected fields, etc. We have used the Soroc in other applications and are comfortable with it. Terminal prices are coming down rapidly, and capabilities are going up, so it pays to shop around.

OUR OBSERVATIONS

With the OS-9 system, the user may have to manage memory. As programs or utilities are used, they are maintained in memory until the user specifically KILLs them. Thus, it is easy to fill memory with routines which are unused and suddenly find yourself out of space for new programs.

The 6809 microprocessor is an advanced 8-bit processor (actually a 16-bit processor internally with an 8-bit data bus). The OS-9 operating system was specifically designed to take advantage of the unique features of the 6809.

The central processor board has additional slots for adding PROM/ROM (read-only memory) which could be used for fixed programs or utilities. In some respects, the Chieftain/OS-9 combination could be considered a development system for control applications. It seems very flexible in hardware capabilities.

USER COMMENTS

- *With 2 CRT's, I had no real problem with its speed. It is of high quality with the most reasonable price. It allows me to have a multi-user capability for a low cost.*
- *We'd like more than 64K, but we can work around it. It's good equipment. Once we got the program going we've been satisfied.*
- *The Soroc 120's are really the only weak link that I can think of.*
- *The Soroc 120 is great. I like the feel of the keyboard, and it's tremendously reliable.*

SMOKE SIGNAL CHIEFTAIN: HARDWARE COMPONENTS

STORAGE

Storage options include 5¼-inch, 8-inch, and 10 or 30 megabyte Winchester hard disks.

5¼-inch	Single-sided/double-density at 160 kilobytes
	Double-sided/double-density at 366 kilobytes
	Double-sided/octodensity at 750 kilobytes
8-inch	Single-sided/double-density at 500 kilobytes
	Double-sided/double-density at 1 megabyte
Winchester drives at	10 megabytes
	or 30 megabytes

OUR OBSERVATIONS

We tested the 9822 dual 8-inch (double-sided/double-density) and the 98W10 with an 8-inch and a 10 megabyte Winchester. About one-third of those surveyed were going to expand their storage capacity, generally by adding hard disks.

USER COMMENTS

- *5½-inch are smaller than what we need but we can't afford 8-inch.*
- *We have 2MB and we're going to get a hard disk.*
- *The double-density floppies are fabulous.*

OTHER DEVICES

Printers: The Anadex printer was very fast, and gave us no problems. Printers, like terminals, have come down in price and increased in capabilities over the past year, and a user should shop around.

Smoke Signal distributes the Anadex, NEC Spinwriters, and Centronics printers.

OUR OBSERVATIONS

Through the Information Exchange (a Smoke Signal supported network of dealer information), you may find industrial applications and hardware for analog to digital conversion, modem boards, numerical and temperature controllers, etc.

The Anadex printer is far superior to earlier versions. It is bidirectional and relatively quiet.

USER COMMENTS

- *I like the Epson very much.*
- *Anadex printers are super (we have two).*

SMOKE SIGNAL CHIEFTAIN: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	DOS69 produced by Smoke Signal OS-9 produced by Microware (Level 1)
Languages:	Under OS-9: BASIC-09, CIS COBOL, Pascal Under DOS: BASIC, Pascal
Access Methods:	Sequential and direct under BASIC-09
Utilities:	In addition to the standard file management utilities, there is a date/time function (to support the on-board clock), log-in by name and password to provide security and limited access, and system management such as memory allocation, disk initialization, etc.

OUR OBSERVATIONS

Using the Chieftain was an interesting (and worthwhile) experience. The feature we most liked was the multi-tasking. It is sometimes frustrating to sit at a computer, waiting for a long report to finish printing. With multi-tasking, you start the listing and go on with other applications.

Also, you can create procedure files (a sequence of system commands). These can be executed as a background task while you continue to use the computer for on-line applications, program development, etc.

The hierarchical file structure makes it easy to separate files by application since you can have multiple levels of subdirectories. Also, since input/output is file oriented, it is easy to copy files to any output device through a simple redirection command.

From BASIC you have easy access to the operating system and can perform operating system level activities from within a program, such as file copies, directory listings, etc. Another useful feature of BASIC is the line-by-line syntax checking as statements are entered. Finally, BASIC has the ability to create data structures (similar to Pascal). Thus, you can create complex record types (such as an employee record) and manipulate the entire record as a single unit, rather than having to manipulate each data element within the record.

Level 1 of OS-9 only supports 64K of memory. Several users were anxiously awaiting Level 2 which will support more memory and more users.

USER COMMENTS

- *DOS is very useable, very bug free. With the hardware and the software, you have a very nice system. OS-9 takes the Smoke Signal up a whole new level of technology.*
- *DOS has its limitations but it works. Level 1 of OS-9 is fantastic. It is not the most convenient for development work, but it is for everything else.*

SMOKE SIGNAL CHIEFTAIN: SOFTWARE COMPONENTS

SMOKE SIGNAL SUPPLIED PACKAGES

No packages are directly supplied by Smoke Signal Broadcasting. However, the Software Exchange, supported by Smoke Signal, makes available a wide range of applications including:

General Applications	Accounts Receivable/Accounts Payable
	Mailing list programs
	Payroll
	Tax preparation
	Text editor/word processing
Industry Specific	Apartment management
	Bill of materials and job costing
	Chiropractic and dental office management
	Real estate
	Radio and television station management

OUR OBSERVATIONS

Most of the dealers are software houses who not only create general application packages, but will develop customized software. Smoke Signal supports the Information Exchange, a network of dealers who distribute hardware and software.

USER COMMENTS

- *I really like the Text Processor.*
- *I don't care for the software that is available for either DOS or OS-9.*
- *Some of the Computerware programs are sloppy. They put them out with syntax errors, Computerware has been less than responsive.*
- *I wish they would work a lot harder at getting software houses to develop software. Then they would have a dynamite product. We have worked very hard to bring the software and hardware together. If we hadn't hired a part-time programmer, we might have been a computer disaster story.*

SMOKE SIGNAL CHIEFTAIN: SOFTWARE COMPONENTS

EDITOR

The BASIC editor is line-oriented and has global search and replace capabilities. In the editor you can insert and delete lines, move the line pointer, and change strings. A line is checked for syntax when it is entered or changed.

OUR OBSERVATIONS

When an error is found during execution of the program, the program stops in debug mode. You must enter the edit mode in order to make program corrections.

We found the editor relatively easy to use, with very few commands to remember. Since you are in an edit mode, you don't have to type the command EDIT for every line you want to modify, but simply list the line and make the changes. This saves a good deal of typing over many of the other editors we have used.

In addition to the BASIC editor, Smoke Signal sells a separate text editor (SE-2) which we did not evaluate.

USER COMMENTS

. *The SE-2 is a Super Text Editor--it was not like any we've used before. We rewrote it. Smoke Signal provides code so users can modify utilities.*

DOCUMENTATION

Variable. What you think of the documentation will depend upon what you already know about computers and what you are interested in finding out. Because it is a modular system (you can mix and match a multitude of hardware and software options), there are technical manuals full of details and schematics, and you really must understand hardware to follow them. The only Smoke Signal software manual we reviewed was for DOS which adequately covered commands, but seemed to assume a good working knowledge of computers.

The Microware manuals were acceptable. Both OS-9 and BASIC-09 included a separate page, in alphabetical order, explaining each of the commands or statements and giving examples. Perhaps a part of our problem with these manuals is that, as Microware points out, you have to unlearn some old concepts before you can understand what OS-9 is capable of doing.

MAINTENANCE

Maintenance is provided by the dealer supplying the system.

TRAINING

The dealers provide training on applications.

OUR OBSERVATIONS

There is a Microware users group and a Smoke Signal users group. We understand there is a quarterly publication, and occasionally special prices are offered to members.

USER COMMENTS

- *Documentation is probably their weakest point, for their software it is excellent. Hardware documentation is extremely limited. Microware documentation for OS-9 is superb.*
- *If Smoke Signal has a weak spot, documentation would be it. It's not fully explanatory. Training was adequate.*
- *Documentation is all right, operating system documentation is okay. Not enough software documentation.*
- *The hardware has been pretty satisfactory and repair has been fast, never down for more than an hour or two. Speed is okay considering I use four floppies. The hardware is reliable.*

SUMMARY OF USER COMMENTS

Using names supplied by the Smoke Signal Broadcasting Company, we interviewed fifteen users of the Chieftain. The firms contacted were using it for standard accounting procedures, word processing, math calculations, and program development. They had owned their Chieftain's from two months to two years. Average useage was about four hours a day, five days a week.

Hardware configurations varied a great deal; none had hard disks, though four of the users had more than one terminal and multiple printers. Several people owned two complete systems. Main memory ranged from 32K to 64K and storage capacity went from 320K to 2MB. Most of the users had Soroc IQ 120's or 135's, but there were many other CRT's in use as well as a wide range of printers. Some complaints about the Sorocs covered "key bounce" (multiple characters at a single keystroke) and sticky keys. A user with Anadex printers said they were "super." The speed of the system for users with two terminals was adequate, or fast, and one user said he was surprised there wasn't more degradation. Those with one terminal said there were no problems with the Chieftain's speed.

The hardware, including peripherals, was uniformly reliable for most of the firms. Several users did have more than minor startup problems though only one of them was dissatisfied with the service received. Others rated hardware service as "fine" or "excellent." In general, hardware dependability was not an issue.

Those doing program development were the most impressed with the system, especially the OS-9 operating system. They said OS-9 was fast, easy to use and efficient. One user was more specific and said the "memory modules, I/O redirection and stack orientation" made OS-9 outstanding. He also said it increased his productivity as a programmer. Other users, while happy with OS-9, mentioned problems with it and were looking forward to Level 2 of OS-9 which would handle more memory and users. The disk operating system (DOS) was also popular with most of those using it because it was "powerful," but some people said it had limitations. A user who was very unhappy with his Chieftain felt DOS was lacking and the software available for it was unsuitable. However, upgrading to OS-9 only increased his dissatisfaction since there was no software written for it.

Lack of software on the market was a problem for some users. In fact, one person was selling his system because of this and buying another computer. Some of the negative comments about the software sold for the Chieftain were that only one company was developing software, this company was "unresponsive," and the programs were "sloppy" and included syntax errors. One user's solution to the software gap was to hire a part-time programmer. He made the following comment. "We have worked very hard to bring the software and hardware together. If we hadn't hired a part-time programmer, we might have been a computer diaster story."

The comments about Microware's BASIC-09 were favorable. It was "very powerful, easy to operate and bordered on being an Assembler." Equally liked were its modular nature, operator interface and the ability to structure data. Some users programmed in Assembler and one in Pascal. Those using SE-2, the text editor, had mixed feelings about it: "it's a marvelous, excellent small editor," or "it's complicated." One user said it was unlike any editor he'd seen before, and he was able to change it to fit his needs.

For some the weak link in the Chieftain was system documentation. Those interviewed said it assumed users were already familiar with the system, the examples were insufficient and there were punctuation errors. Some thought the hardware documentation was "limited" but the software manuals were "excellent," or that there wasn't enough software documentation. Other support through dealers and the manufacturer was generally good. One user said, "Smoke Signal has been a very cooperative company."

The most remarkable features of the Chieftain for these users were the hardware dependability and the capability and power of the system for the cost. Its drawbacks were limited and unprofessional documentation and a lack of application software. Two representative comments are the following: "Best feature is reliability, they don't quit. Worst feature is the hardware documentation." "I wish they would work a lot harder at getting software houses to develop software. Then they would have a dynamite product."

CONCLUSIONS

The Chieftain from Smoke Signal Broadcasting features a very capable system based on the Motorola 6809 microprocessor chip. The integrated portion of the system includes the dual 8-inch floppy disk drives (or the single 8-inch drive and Winchester disk we tested as an alternative), while any standard CRT terminal and printer can be used with the system.

We found users to be generally satisfied with hardware reliability, and most were pleased with the OS-9 operating system. As we often find, there were several negative comments on the documentation, principally because it was too technical. The other major negative feature of the Chieftain was the apparent lack of application software, though we feel software will be developed as the system becomes more widely distributed.

The Chieftain is among the fastest of the systems tested in this series. The operating system and BASIC language were specifically designed to take advantage of the unique characteristics of the 6809 microprocessor.

The BASIC-09 language which runs under the OS-9 operating system has some very nice features. These include structured flow-of-control statements, the ability to execute operating system commands from a BASIC program, and the TYPE statement (as in Pascal) which allows the construction of complex data structures.

The OS-9 operating system is a derivative of UNIX, and features a hierarchical file directory structure, file-oriented input/output, simple redirection of output or input, and multi-tasking/multi-user capabilities.

As a single-user system with multi-tasking capabilities, the Chieftain should increase throughput since several tasks can be executed simultaneously from a single terminal. With the possibility of becoming a multi-user system, it provides a relatively inexpensive entry level system.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

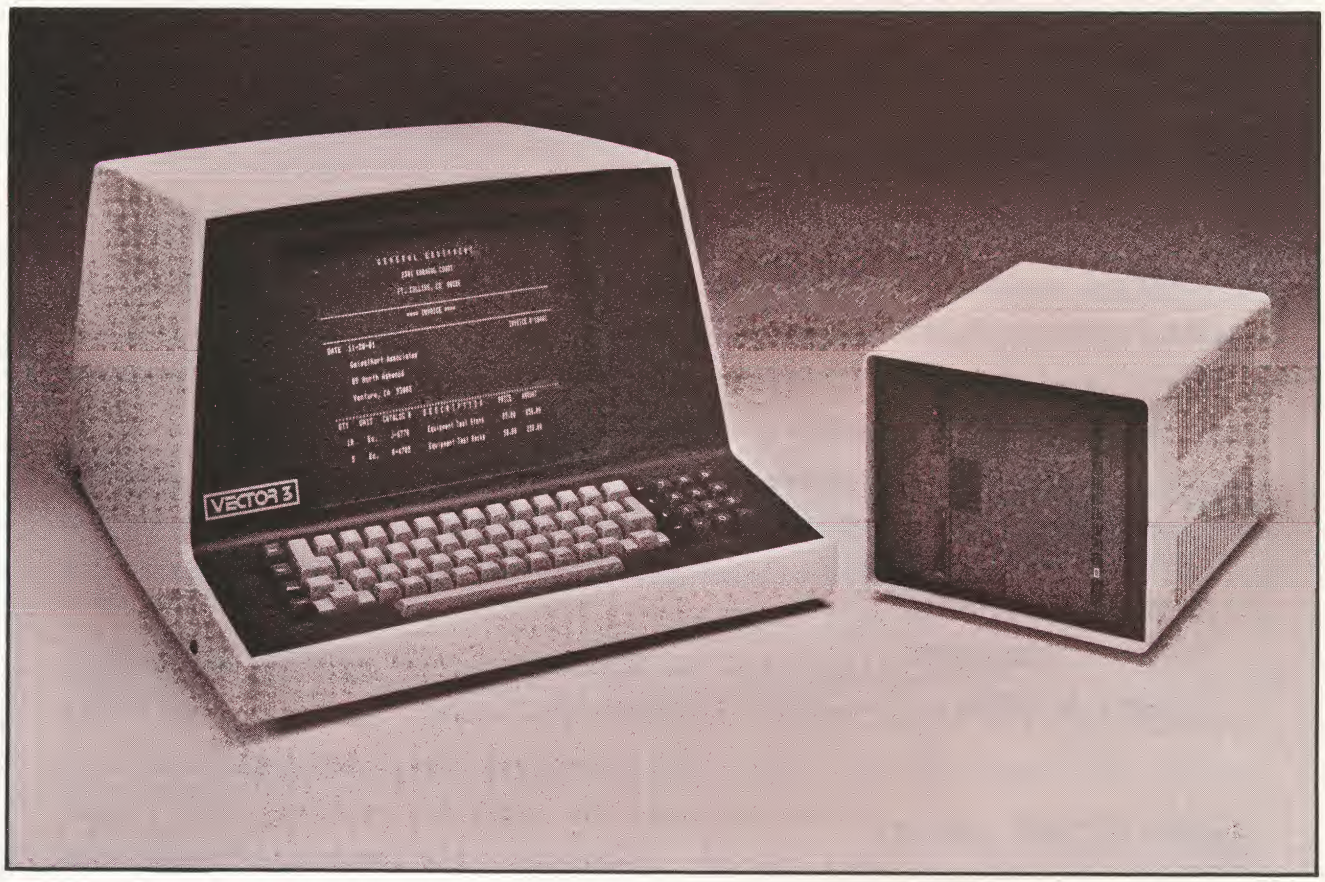
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 11, DECEMBER 1981



In This Issue:

The VECTOR GRAPHIC 3005

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

VECTOR GRAPHIC 3005: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: Vector Graphic 3005	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

This evaluation of the Vector Graphic 3005 is the tenth report in our continuation of Series 1 and 2. Systems in this series cost under $25,000 and are designed principally for single-users. The 3005 is configured with a small hard disk and costs, as tested, $11,150.

The benchmark programs used in preparing these reports represent capabilities needed by users in an operating environment. The results of running these programs on each of the systems under study forms the heart of these reports, and they provide comparative information which is simply unavailable from any other independent source. Since the programs have been designed to run without change on most small computer systems, differences in performance among systems can be attributed to differences in computing capabilities.

In addition to the benchmark results, these reports contain information on the alternative configurations which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on the ease of use of the system. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report. The experiences of users add a dimension of reality to the technical details of the system.

Information provided by manufacturers can often be difficult to interpret and sometimes misleading. While some of the potential buyers of microcomputers have some background with computers, the majority we've surveyed are buying their first computer, and often the personnel using it will not have had much direct experience with computers. We feel these reports are invaluable to experienced and inexperienced users alike by providing an unbiased assessment of some of the microcomputer systems on the market today. Our results, which are comparable across computer systems, and our observations of the system in a "real world" setting can help potential users intelligently select a system that is best for them.

EXECUTIVE SUMMARY

The Vector Graphic 3005, priced at $11,150 as tested, consists of a V3 terminal with a 12-inch display area, typewriter keyboard, a Z-80A processor, 56 kilobytes of central memory and three parallel and one serial RS232C ports. The printer we used was a 55 character-per-second Qume Sprint 3. Storage consisted of a 5 megabyte Winchester hard disk and a double-sided, quad-density floppy disk drive providing an additional 630 kilobytes of on-line storage. This configuration, excluding the printer, distinguishes the 3005 and is non-expandable.

- The 3005 employs a quasi single-board technology with the processor chip, a buffer, PROM, and one serial and three parallel ports on one board that is S-100 compatible. The terminal controller and RAM are separate.

- It is an integrated system which takes the burden of needing a high level of computer knowledge off the buyer. It can also be used as a non-intelligent terminal for communications with another computer.

- Although the Vector Graphic comes with a hard disk, using only its floppy disk it ranked in the top third in speed, except for the Accounts Receivable program where its performance was below average. Hard disk performance was average compared to the other hard disk systems we've tested though its cost is less than most other hard disk systems.

- Virtually any language can be used with the 3005 because of the CP/M operating system. We ran the benchmark programs using Microsoft's BASIC-80, a straightforward, easy to use, high level business BASIC. SCOPE is a text editor that we thought was particularly useful and is a special bonus for 3005 programmers.

- The twelve users who responded to our user survey were happy with the 3005. They especially liked the hard disk, dealer support, hardware reliability and the price. They were unhappy with the documentation, primarily because it was too technical and hard for a novice computer user to understand.

- Vector Graphic markets some application packages, and users singled out Memorite III and ExecuPlan as having special merit. Also available for the 3005 are the many CP/M compatible application packages on the market.

Vector Graphic has well designed hardware and this, coupled with their software offerings, makes the 3005 a powerful and versatile tool for businesses and non-business users alike. Costing just around $11,000, the 3005 should definitely be on the "must see" list of anyone shopping for a computer; but as always, the reliability of the local dealer should also be a consideration.

BENCHMARK REPORT

SYSTEM: VECTOR GRAPHIC 3005

PRICE AS TESTED: $11,150*

SPEED TESTS

Benchmark Number		TOTAL TIME** Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500		26.5
A-2	N = 1000		51.5
A-3	N = 2000	1	41.8
A-4	N = 3000	2	32.1
A-5	N = 500		7.4
A-6	N = 1000		13.6
A-7	N = 2000		26.0
A-8	N = 3000		38.3
	I/O INTENSIVE		
B-1	N = 500		35.0
B-2	N = 1000		41.3
B-3	N = 2000		56.9
B-4	N = 3000	1	13.7

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME** Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	11	34.1
C-1A		4	12.2
C-2	NEW PRODUCT PLANNING		13.1
C-2A		1	18.8
C-3	ACCOUNTS RECEIVABLE	7	45.6
C-3A		9	49.7

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	208
E-2	SUBJECTIVE JUDGMENT	Easy

* This price includes the 5 megabyte hard disk.

** Note: For the hard disk times, see pages 9 through 12.

THE BENCHMARK PROCESS

The Benchmark programs were run on the Vector Graphic 3005 which features a 5 megabyte hard disk, one double-sided floppy disk drive, a Z-80A processor running at 4 MHz, 56 kilobytes of central memory, a V3 terminal, and a Qume Sprint 3 printer. These components had been set up in the Association of Computer Users' office in Boulder, Colorado, and had been in use for some months. Therefore, "personalization" or system generation procedures were unnecessary. Generally, personalization will be done for the user by the local dealer.

The benchmark process went exceptionally well and trouble free. The 3005 is a Z-80A, S-100, CP/M, and BASIC-80 system, so it was very similar to other systems we've tested. Virtually all that was required was typing the programs in and editing a few syntax errors. After this was completed we ran the timings.

Our familiarity with CP/M and Microsoft's BASIC-80 meant that we did not need to refer to the manuals as often as we do when testing unfamiliar equipment. However, we reviewed the documentation and were reminded of the content and organization of Digital Research's and Microsoft's manuals. Our criticism is that they are not very helpful to new computer users as either learning tools or as references. All the manuals clearly state that the documentation is not intended for the non-programmer end user, but instead is geared toward suppliers and experienced computer users. Notwithstanding this acknowledgement, we feel a more basic offering would benefit users and dealers alike. It would allow users to explore the system with their own needs in mind and not be as dependent upon dealers.

The 3005 includes a 5 megabyte hard disk which we used to "boot" the system. To obtain the floppy disk times we inserted a diskette that contained only the benchmark programs on it in drive C (the floppy disk drive). Then we loaded and ran the programs from that disk. For the two programs (I/O-Intensive and Accounts Receivable Generation) that create and access data files we also ran hard disk timings.

All programs are run with output to the screen. The programs that also test output to the printer were modified so that all PRINT statements were changed

to LPRINT. To obtain the benchmark timing, each program was loaded into memory, the RUN statement typed in, and the stopwatch started when the carriage return was entered. Timing was stopped when output was complete.

Microsoft's enhanced version of BASIC is a pleasure to use, and offers high level and structured programming capabilities. One convenience missing, though, is immediate syntax error checking. Although this feature is not often available on microcomputers, it greatly facilitates program entry and development. We were using Version 5.2 of BASIC-80 with Version 2.22J of CP/M. Some of Microsoft's enhancements are listed below.

- Multiple statements on a line and a 255 character line length using the line-feed key,
- Constants that include string, floating point, hex and octal,
- Automatic numbering and renumbering of statements,
- IF . . . THEN . . . ELSE and WHILE . . . WEND statements;
- Assembly language subroutine calls,
- Immediate execution of statements by not typing a line number before the statement,
- Error trapping capabilities,
- Mathematical functions including exponentiation, floating point, and double precision,
- User defined functions, type conversion, and chaining and merging of programs.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TEST: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500		26.5 seconds
A - 2		N = 1000		51.5 seconds
A - 3		N = 2000	1 minute	41.8 seconds
A - 4		N = 3000	2 minutes	32.1 seconds

Comment: This program does not use the hard disk.

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations on the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500	7.4 seconds
A - 6		N = 1000	13.6 seconds
A - 7		N = 2000	26.0 seconds
A - 8		N = 3000	38.3 seconds

Comment: This program does not use the hard disk.

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disk and then hard disk, and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500		35.0 seconds
B - 2		N = 1000		41.3 seconds
B - 3		N = 2000		56.9 seconds
B - 4		N = 3000	1 minute	13.7 seconds

Comment: The hard disk times were 15.3 seconds, 19.0 seconds, 26.4 seconds, and 34.0 seconds, respectively.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$
$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$
$$\vdots$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	11 minutes	34.1 seconds

Comment: This program does not use the hard disk.

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results:	4 minutes 12.2 seconds

Comment: This program does not use the hard disk.

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

C - 2	Results:	13. 1 seconds

Comment: This program does not use the hard disk.

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	1 minute 18.8 seconds

Comment: This program does not use the hard disk.

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results:	7 minutes 45.6 seconds

Comment: The hard disk time was 2 minutes and 26.9 seconds.

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results:	9 minutes 49.7 seconds

Comment: The hard disk time was 4 minutes and 29.6 seconds.

EASE OF THE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 208 keystrokes were required to edit the nine-line test file.

Comment: The BASIC-80 editing facilities are not very efficient in terms of keystrokes, but they are easy to use.

VECTOR GRAPHIC 3005: PRICING COMPONENTS

COSTS

Vector Graphic 3005, as tested $11,150

Includes:

- 56 kilobytes of central memory
- 5¼-inch Wincester hard disk (5 megabytes)
- One 5¼-inch double-sided quad density floppy disk drive (630K)
- Microsoft's BASIC-80
- CP/M operating system
- Qume Sprint 3 printer
- V3 terminal
- 3 parallel and one RS232 serial port

Components

- 3005 (without printer) ..... $ 7,950
- Qume Sprint 3 printer ..... $ 3,200

OUR OBSERVATIONS

Vector Graphic sells their computers through a network of dealers. The 3005 is an integrated system including the Sprint 3 printer, other printers however, are often used with it. The system we tested was installed on top of an ordinary office desk, but special desks and printer stands may also be purchased.

We feel the speed of the system, its capabilities and cost make it a good buy for many businesses, although disk capacity may be a factor for some to consider. The users we talked to felt they made a good choice when they bought the 3005.

USER COMMENTS

- *We love the 3005. We enjoy using it.*
- *They give the customer more product for the money: quality and capacity.*
- *We're basically pleased with what we got. Biggest challenge is using it to its potential.*
- *Best feature of the 3005 is that the system is extremely well thought out.*
- *The 3005 has great hardware reliability.*

VECTOR GRAPHIC 3005: HARDWARE COMPONENTS

CENTRAL UNIT .... The central unit is housed in the V3 terminal and includes a Z-80A processor, an S-100 bus, three parallel and one serial port, and six S-100 slots (four are used in the system). The disk drives are contained in a separate unit.

CPU Memory: It is a 56K system. There are 64 kilobytes of central memory of which 8K is used for system overhead, leaving 56 kilobytes for the user.

Keyboard/Screen: The V3 terminal has a typewriter keyboard with a separate 10-key numeric keypad. The 12-inch grey phosphor screen displays 24 lines of 80 characters with reverse video capability.

OUR OBSERVATIONS

The units easily fit on a desk top. It is solid looking and the disk drives are relatively quiet. One of the drawbacks of the keyboard is that there is no ENTER key located near the 10-key pad, making it necessary to move the hand for entering numbers.

CP/M systems generally have 64 kilobytes of central memory so most off-the-shelf packages will work on this system. The Z-80A and S-100 bus are in common usage but the 3005 ran a little faster on the benchmark programs than other similarly configured systems we've tested.

The CRT is memory mapped through the Flashwriter board. Characters are formed in an 8 x 10 dot matrix. Users can define an alternate character/graphics set which can then be installed in a read-only-memory.

USER COMMENTS

- *It's very fast.*
- *It's plenty fast. We're not in a deadline situation like payroll.*
- *It would be nice to have more than 56K. Speed is fine. I like the system.*
- *The system appears very versatile and able to handle our needs.*
- *I would prefer a green face on the V3.*
- *Nothing wrong with the keyboard and screen.*
- *The keyboard is very sensitive to the touch, often causing unwanted letters being entered. I would like to see the numeric keyboard redone.*
- *The V3 is very good except eyestrain might be reduced with a green phosphor screen or green plastic cover.*

VECTOR GRAPHIC 3005: HARDWARE COMPONENTS

STORAGE

A Seagate 5 megabyte Winchester hard disk and a Tandon 5¼-inch quad-density, double-sided floppy disk drive will hold 5.8 million characters of information. The floppy disk alone will provide 630 kilobytes of on-line storage.

OUR OBSERVATIONS

Since the 3005's storage is not upgradable, a user is locked into 5.8MB maximum and should carefully assess storage needs before buying a computer. In this respect, the 3005 is comparable to many other computers in that this storage capacity is at the low end of the manufacturer's product line. These 4 to 6 megabyte systems will be good for some businesses, while other may need more disk storage.

USER COMMENTS

- *For what we're doing, we can store everything we need to.*
- *We're pushing the 5 megabytes. We want to go to a larger hard disk. If I had dual floppies I actually think I'd need less hard disk space.*
- *Five megabytes hard disk is plenty for me in the foreseeable future. Speed and convenience are great. I use floppies for backup.*
- *Data storage capacity is very good, excellent speed of access.*
- *The storage capacity meets my needs. The storage and convenience of five megabytes really spoils the operator. The speed and quietness of the hard disk over the floppy is nice.*

OTHER DEVICES

Printers:

- Qume Sprint 3

  55 characters-per-second
  letter quality
  paper width up to 14 inches

- Vector 7700 (NEC Spinwriter)

  55 characters-per-second
  letter quality

Printer stands, paper catchers and sheet feeders are available.

OUR OBSERVATIONS

The Sprint 3 worked well for our tests and produced excellent letter quality print. We feel though, that it is somewhat overpriced. Not only does it print at a minimum speed but all functions must be software selected. The only mechanical capability is turning the roller to advance the paper. Several users had NEC Spinwriters and no one we spoke to was using a Sprint 3.

USER COMMENTS

. *The NEC printer is good.*

. *The Qume 5000 is great.*

. *The NEC Spinwriter is great for technical writing with equations.*

. *The Paper Tiger works well.*

. *The Epson MX-80 is excellent.*

. *The Anadex printer is nice.*

VECTOR GRAPHIC 3005: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	The Vector Graphic operating system is a slightly enhanced version of CP/M.
Languages:	BASIC, FORTRAN, COBOL, Pascal, and other languages available on the CP/M system.
Access Methods:	In Microsoft BASIC-80, there are sequential and random record access methods.
Utilities:	In addition to the standard file manipulation (copy, rename, etc.) and disk management (format, etc.), there is a configuration utility for defining the type of attached printer, and a screen editor to replace the standard CP/M editor.

OUR OBSERVATIONS

The wide range of software available under the CP/M system is an asset. Also, with many programming languages to select from, almost any programming requirement can be met.

In an integrated system, certain features can be built in which facilitate programming and application development. The 3005 has memory mapped input/output to the screen, so cursor control and form fill-outs are relatively easy to program.

The system has a built-in monitor which provides direct access to memory for examination, moving blocks, comparing two blocks of memory, etc. The monitor also provides the input/output routines for the CRT and keyboard.

USER COMMENTS

- *BASIC-80 is great.*
- *The 3005 is easy to use and accessible.*
- *This system is good as it stands. It's pretty well thought out. Speed depends on the program, but we're not pushing it.*

VECTOR GRAPHIC 3005: SOFTWARE COMPONENTS

VECTOR GRAPHIC SUPPLIED PACKAGES

Memorite III - word processor

ExecuPlan - video calculator

Peachtree General Accounting Software

CCA - data management system

Statpak - statistical package

Correct, RBTE, BSTAM - communications software

OUR OBSERVATIONS

It is a definite plus when the hardware manufacturer also supplies application programs. Although the Peachtree programs were not developed by Vector Graphic, they are supported by them and should run without major modifications on the 3005. Memorite III and ExecuPlan were very well liked by the users in our survey. One user commented that he particularly liked the 30,000 word spelling dictionary in the Memorite package.

USER COMMENTS

- *ExecuPlan is pretty neat. It's a good worksheet.*
- *Memorite is fairly nice. Drawback is that it doesn't show control characters and you don't see what will print. ExecuPlan doesn't have the flexibility we'd like.*
- *Vector Graphic's edition of Peachtree payroll is a little slow, but it does the job very effectively. I love ExecuPlan.*
- *Memorite III is an outstanding word processing program. It has a few bugs.*
- *Memorite III is simple to use. I prefer it to Wordstar which I also have. The instruction manual is not organized for quick reference which is a large disadvantage. ExecuPlan is an excellent electronic worksheet. The instruction manual is very poorly done.*
- *Peachtree business accounting works well.*

VECTOR GRAPHIC 3005: SOFTWARE COMPONENTS

EDITOR

There are three options for editing with the 3005: the interactive BASIC-80 editor; CP/M's editing utility ED, or SCOPE (Screen Oriented Program Editor), Vector Graphic's text editor.

Microsoft's editing functions are strictly line-oriented with no global search and replace capabilities. Typing EDIT and the line number puts the line in a buffer where characters can be deleted or inserted. Additionally, there are some control functions that act on the current line being typed in and will put it in edit mode or retype it. Control I enables tab stops at every eighth character.

The ED utility creates a working file that can be modified. While it is line-oriented, it does allow global search and replacement of strings and appending of text.

The full-screen editor SCOPE features scrolling, paging of text in and out of the buffer, display of all control characters and a HELP menu which lists and briefly explains the SCOPE commands. The cursor can be moved anywhere on the screen and text inserted or deleted.

OUR OBSERVATIONS

We used Microsoft's interactive editing functions for program entry. While in BASIC-80, these editing commands are automatically available and are simple to learn and invoke. We also briefly examined SCOPE which we thought was an excellent tool for the programmer.

USER COMMENTS

- *The editing facilities are very nice.*
- *Editing with BASIC-80 is great.*
- *SCOPE is very good.*

VECTOR GRAPHIC 3005: SUPPORT SERVICES

DOCUMENTATION

There are manuals about CP/M, BASIC-80, and Vector Graphic components such as hardware and SCOPE. They are grouped together into two binders under the headings "Operating System and Utilities Software" and "Hardware." The hardware information is quite adequate for the average user but would not address the electronics expert's needs. The software manuals are only average; they are complete but are more for the experienced computer user rather than a beginning programmer/operator.

Users felt the documentation was lacking, especially since it was not written for the novice user and was too technical and hard to follow.

MAINTENANCE

Vector Graphic supplies a standard 90-day warranty with the system.

TRAINING

Training and instruction are left to the dealers and suppliers to provide.

USER COMMENTS

- *We had to wait a little while for parts. The software manual is excellent. Training was adequate.*
- *They have good documentation.*
- *A weakness of the 3005 is the lack of good documentation and people at Vector Graphics who know what they're doing.*
- *Great hardware service, excellent software service. Vector Graphic's documentation is fine.*
- *The documentation is good, although they have trouble keeping up with the hardware.*
- *The documentation is mediocre. This slowed the introduction of the 3005 into our business. It is disjointed and contains numerous errors and omissions. I have reported software problems to Vector Graphic and they acknowledged most of the problems. So far, I have not gotten any fixed.*

SUMMARY OF USER COMMENTS

Using names supplied by the Vector Graphic Corporation, we surveyed twelve users of the 3005 which they had owned from three to six months. They gave the following reasons for choosing the 3005: software available, proximity of the dealer, price, the 5 megabyte hard disk, dealer support, and Vector Graphic's reputation. The 3005 was being used by doctors' offices, manufacturers, a retail sales outlet, and engineering and software consultants. It was being used for financial reporting, accounting, payroll, and inventory control.

The hardware configuration varied only with the type of printers being used, and all of the users were pleased with the particular printer they had. Users also generally liked the keyboard and screen on the V3 terminals. Three users said they would prefer a green phosphor screen instead of the grey screen. These users felt that the hardware was dependable, although about half cited significant problems at startup. These problems centered mostly around the hard disks, controller and memory boards.

The 5 megabyte hard disk and floppy disk drive provided plenty of storage for all but one user who said he was pushing the maximum capacity. He also felt that backing up with the hard disk and one floppy was ackward. Several users said that backing up was slow. On the other hand, there were people who said backing up and disk access were fast. Central memory of 56K was also enough for most programs and did not constrain any of the users. System speed was also not a problem except for one of the users. He said that the 3005's worst feature was that it was slow, but, overall "it was an excellent system."

Only two of the users were wholly dependent upon third-party programs, and all but four users were combining third-party packages and in-house programming. The other four users were exclusively running their own programs. Everyone was using Microsoft's BASIC-80 and one person was also programming in FORTRAN. There were few comments about these languages other than about BASIC-80 which users said was "powerful," or "great."

Users' enthusiasm was directed toward Vector Graphic's application programs ExecuPlan and Memorite. They said ExecuPlan was an "excellent electronic worksheet," and were quite pleased with its capabilities, although one person said it didn't offer his business the flexibility they needed. Memorite was

simple to use, and had nice features such as a spelling dictionary and mailing list. Some users felt that it had "bugs" in it or a few limitations, but overall, they were happy with its performance. One user thought a "large disadvantage" of both ExecuPlan and Memorite was that the accompanying instruction manuals were not organized for "quick reference" and were "poorly done." Peachtree accounting programs were being used by two firms. One person said it "worked well," and another said that payroll was slow, but "it did the job very effectively." Several users mentioned the editing utility SCOPE and said they liked it. There were not many comments about BASIC-80's editing facilities but those who did comment liked its features.

Support of these users by their dealers was viewed as above average. Those needing hardware repairs said service was good, although one user felt he shouldn't have had to wait for parts as long as he did. Few users mentioned problems with the software and also got good support in this area. However, one user said Vector Graphic acknowledged the problems he was encountering but they had not followed through and fixed them yet. Most of the users who required training said it was "adequate."

Vector Graphic's documentation drew the largest number of negative comments. Five users rated it fine, good, or the best they'd seen. It should be noted though, that the person who said it was good and the other person who said it was the best he'd seen, were not programming, and no one in-house was programming. Those who disliked the documentation said it was mediocre, poorly organized, disjointed, and lacked examples and contained errors and omissions. By far the most irritating aspect of the manuals for the users was that they were not suited for inexperienced users and did not provide basic information.

Overall, the users were happy with their choice of the Vector Graphic 3005. Different users felt it had different strengths and weaknesses. Mentioned as some of its best features were the 3005's speed, Vector Graphic software and utilities, the 5 megabyte hard disk, and hardware reliability. Some drawbacks were that it was slow, one floppy and a hard disk were ackward, and the documentation was limited and needed improvement. Some of the users said they loved the 3005, they enjoyed using it, and that the system was "pretty well thought out."

CONCLUSIONS

The Vector Graphic 3005 is built around the Z-80A processor/S-100 bus combination and uses the CP/M operating system. This configuration and its performance are similar to other systems we evaluated in this series. Differences arise in enhancements to the hardware, operating systems and manufacturer and field support. Another area of special consideration is the software offerings of the manufacturer. Vector Graphic does supply application packages including a word processor, a video worksheet, and also markets the Peachtree accounting programs with their systems.

Overall, the users we surveyed were pleased with almost every aspect of the 3005. Memorite III and ExecuPlan were quite popular, as was the text editor, SCOPE, which several users were using for program development. Users had been receiving good support from their hardware and software suppliers, but felt the manuals were a problem. Their primary criticism of the documentation was that it was too technical and hard to follow for the first time user. We think both the hardware and software manuals are complete and useful, but agree that they are written for an audience of experienced users.

To benchmark the 3005, we used Microsoft's BASIC-80. It is an enhanced business BASIC that offers many features and capabilities not found in many other BASIC's. The CP/M operating system provides comprehensive file and disk manipulation utilities. Also under CP/M, a large selection of other languages is available.

The 3005's performance was above the average of other Z-80A and CP/M systems we've tested. Vector Graphic supplies software that runs without modifications. The 3005 is a single-station, nonexpandable system and that may be a limitation for some applications. However, for anyone needing a single terminal system with 5.8MB of hard disk capacity, the 3005 will be a good choice.

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

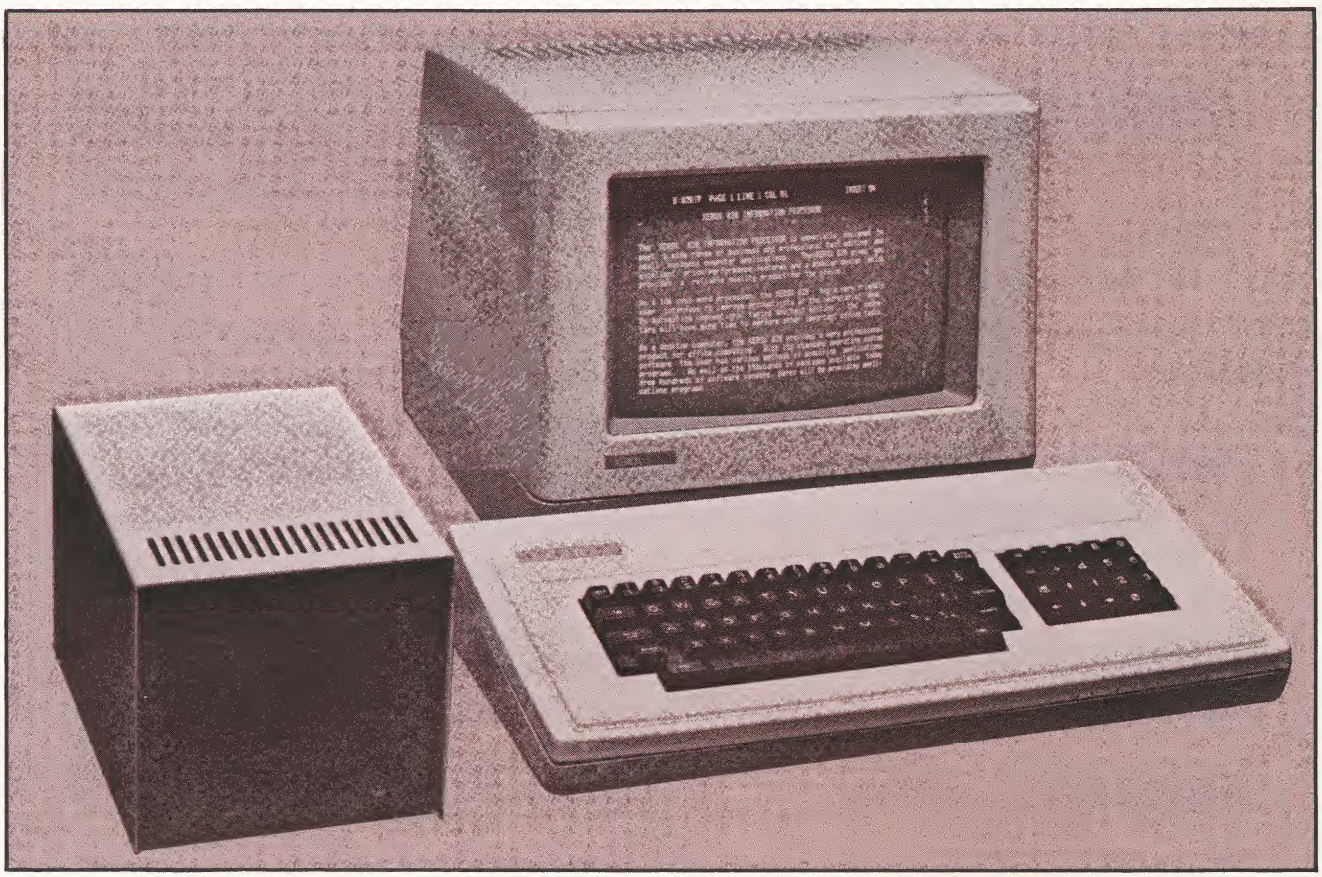
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 12, DECEMBER 1981



In This Issue:

The XEROX 820

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

XEROX 820: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: Xerox 820	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

This report on the Xerox 820 is the final system to be reviewed in this continuation of Series 1 and 2 Benchmark Reports. Included in this series have been systems designed primarily for single users and costing under $25,000. The Xerox 820 represents another large system vendor's entry into the single-user, non-expandable market. While sold as a stand-alone word processing/computing system, it also appears suited as a remote intelligent workstation in an integrated Xerox network.

The advantages and disadvantages of any system can only be judged in terms of a user's unique applications or requirements. Important factors may include raw performance, storage capacity, software availability, user-friendly operations, size, expansion capability, hardware reliability, programming ease, training, and/or a multitude of other characteristics.

Because of the potential "pitfalls" in purchasing a computer system, it is to everyone's benefit to learn as much about computers as possible, even in light of the trend towards user-oriented and turnkey systems. From our user surveys, we've found that overall, the most satisfied end-users are those who are most knowledgeable about computers. They know the limitations of a small computer system and consequently have the most realistic expectations of what a computer will do for their business.

Our benchmark reports continue to be a valuable resource for sifting through the often subtle differences among small computer systems. These reports provide the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. Additional information is given on the alternative configuration which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on ease of use. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report.

EXECUTIVE SUMMARY

The configuration of the Xerox 820 we tested included a Z-80A processor, 64 kilobytes of central memory, dual 8-inch single-sided, single-density floppy disk drives (482K total), two parallel and two serial ports, and a Diablo 630 40 character-per-second printer. Total cost of the system as tested was $7,220 including a $2,900 printer. Smaller (5¼-inch) disk drives may be purchased. Xerox sometimes refers to the 820 as SAM--Simply Amazing Machine.

- The 820's timings were in the middle of other systems we've tested on all the benchmark runs except the Accounts Receivable problem where it placed in the top third.

- The 820 is generally marketed with the Diablo 630 printer. Other printers, however, can be supported by the system. Xerox provides software that enables the 820 to emulate a teletype machine and to act as a non-intelligent terminal for a data link with another computer.

- Xerox distributes the CP/M operating system, BASIC-80, CBASIC, and COBOL-80 for the 820. Xerox also supplies the Word Processing System for text processing applications. Under CP/M, additional languages and software packages can be run on the 820.

- Documentation for the system includes the manuals normally supplied with CP/M and BASIC-80.

- Maximum on-line storage with the 8-inch single-sided/single-density drives is only 482 kilobytes--a definite limitation of the system. We found the keyboard to be of lower quality than normal and the video display had poor resolution.

- Unfortunately, Xerox did not provide us with a machine for testing, nor a list of user names for the user survey normally included in the Benchmark Reports. A local source provided us with a machine for testing, but we were unable to conduct a user survey.

Xerox is an established, reputable manufacturer of business machines. They have taken popular and proven hardware and software components, integrated them into the 820, and entered the small computer market. The 820 was designed for text processing applications but adequately meets some other small business computer needs as well. Its place in the market is as an inexpensive microcomputer/word processor for a small business, or as a larger capacity home computer.

BENCHMARK REPORT

SYSTEM: XEROX 820

PRICE AS TESTED: $7,220

SPEED TESTS

Benchmark Number		TOTAL TIME Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500		54.6
A-2	N = 1000	1	46.8
A-3	N = 2000	3	31.3
A-4	N = 3000	5	17.3
A-5	N = 500		15.4
A-6	N = 1000		28.4
A-7	N = 2000		54.7
A-8	N = 3000	1	20.7
	I/O INTENSIVE		
B-1	N = 500		59.0
B-2	N = 1000	1	8.3
B-3	N = 2000	1	26.5
B-4	N = 3000	1	45.9

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	24	37.0
C-1A		8	56.6
C-2	NEW PRODUCT PLANNING		10.6
C-2A		1	53.7
C-3	ACCOUNTS RECEIVABLE	5	30.1
C-3A		8	36.0

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	208
E-2	SUBJECTIVE JUDGMENT	Easy

THE BENCHMARK PROCESS

All benchmarks were run using Microsoft's BASIC-80 interpreter under the CP/M operating system. The Xerox 820 consisted of a Z-80A interpreter based microprocessor, 64 kilobytes of main memory, dual 8-inch floppy disk drives, keyboard, CRT, and a Diablo "daisy-wheel" printer. We tested this system at a user's site, so we are unfamiliar with any unpacking or set-up procedures.

As a CP/M system with BASIC-80, both of which we have used on several other systems, we had no problems entering and debugging our benchmark programs. When first turned on, the Xerox 820 is in the system monitor mode where a programmer can directly examine and manipulate memory contents (much like the facilities in DDT, Dynamic Debug and Trace, under CP/M). One of the monitor commands loads and transfers control to the CP/M operating system.

Once the system is up and running, the user has available a wide range of utilities under CP/M, including file manipulation, the above mentioned DDT, a Z-80 assembler, and a text editor. In addition, there are many utilities, application packages, and languages which can be purchased from Xerox or independent suppliers, and which are designed to run under the CP/M operating system.

We used Microsoft's BASIC-80 in our benchmark tests. While the BASIC reference manual is helpful and easy-to-use, it assumes a working knowledge of the BASIC language, and should not be treated as a learning tool by novice programmers. The manual contains numerous examples and cross references. The CP/M reference material is generally written for the system programmer, not the end user, so it tends to be relatively technical. Those features designed for the end user, such as file manipulation and text editing, are readable but terse.

BASIC-80 is widely used, and some of its features include:

- IF . . . THEN . . . ELSE and WHILE . . . WEND statements that allow some structured programming.
- Automatic line numbering and renumbering facilities.
- User defined functions and assembly language subroutine capabilities.

- Immediate mode execution of statements (if you type a statement without a line number, it is executed immediately).

- Error trapping, where the user can control program flow when an error occurs and avoid undesired program terminations.

- A COMMON statement which allows variables to be passed from one program to another when they are CHAINed together (where a single large program can be broken into two or more smaller programs, and the termination of one automatically begins execution of another).

- Tracing of program execution where each line number and associated variable values will be printed out each time a line is executed.

The one feature we miss in BASIC-80 is line-by-line syntax checking. When you make typing errors or just type an incorrect statement (like we all do), it's nice to know it immediately. BASIC-80 does not perform a syntax check until the first time it tries to execute the statement. If the statement is at the end of a long program, you won't know it is wrong until the program has nearly completed. This feature is most useful in a program development environment.

To run the benchmark tests, we typed in the programs, debugged them, and saved them on disk files. All programs were run with output to the screen. For those programs having printed output, a control character (Control-P) is all that is required to route output to the printer. The programs were loaded into memory, and timing was started on entry of a carriage return and stopped when program output was complete.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500		54.6 seconds
A - 2		N = 1000	1 minute	46.8 seconds
A - 3		N = 2000	3 minutes	31.3 seconds
A - 4		N = 3000	5 minutes	17.3 seconds

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500		15.4 seconds
A - 6		N = 1000		28.4 seconds
A - 7		N = 2000		54.7 seconds
A - 8		N = 3000	1 minute	20.7 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disks and retrieves the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500		59.0 seconds
B - 2		N = 1000	1 minute	8.3 seconds
B - 3		N = 2000	1 minute	26.5 seconds
B - 4		N = 3000	1 minute	45.9 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$

$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$

$$\vdots$$

$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	24 minutes	37.0 seconds

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results:	8 minutes	56.6 seconds

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Direct Labor
- Packaging
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes
- Taxes Payable
- Net Income

C - 2	Results:	10.6 seconds

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	1 minute	53.7 seconds

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results:	5 minutes	30.1 seconds

Variation: C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A	Results:	8 minutes	36.0 seconds

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage

- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 208 keystrokes were required to edit the nine-line test file.

Comment: BASIC-80's line-oriented editing facilities are easy to use, but they are not very efficient to use in terms of keystrokes.

XEROX 820: PRICING COMPONENTS

COSTS

Xerox 820 (as tested) $7,220

Model 820 includes:

- Z-80A central processor
- CRT
- 64K of central memory
- 4K of read-only-memory (system monitor)
- Dual 8-inch floppy drives (each holding 240 kilobytes)
- Printer (Diablo 630)
- CP/M operating system
- BASIC-80

Components

• Xerox 820 with memory, and dual 8-inch disk drives	$3,795
• Diablo 630 printer	2,900
• CP/M operating system	200
• BASIC-80	325

OUR OBSERVATIONS

The Xerox 820 is distributed through Computerland and Xerox Stores. It is promoted as an Information Processor, with emphasis on doing both word processing and computing.

The word processing capability is based on the WordStar package running under CP/M. Other packages for computing, programming, etc., are distributed by Xerox and independent suppliers of software.

(Xerox did not provide user names, so we are unable to include user comments.)

XEROX 802: HARDWARE COMPONENTS

CENTRAL UNIT	The Xerox 820 is a single board computer housed in the CRT unit. It is based on the Z-80A microprocessor, and includes on the board an interval timer (for real-time applications), two parallel and two serial ports, the monitor, and memory.
CPU Memory:	The system comes with 64 kilobytes of user memory. In addition, the monitor resides in read-only memory (4K ROM).
Keyboard:	The detached keyboard has a standard 96 characters, along with cursor control keys, and a ten-key numeric keypad.
Screen:	The CRT is an 80 character by 24 line display device which also houses the microcomputer hardware.

OUR OBSERVATIONS

If there were such a thing as an industry standard single-user microcomputer, the 820 would have everything in its class: 96-character keyboard with separate 10-key numeric pad, serial/parallel ports, 12-inch CRT, a Z-80A processor, and the CP/M operating system. Added features of the 820 are an interval-timer which is a modified real-time clock, a separate ROM for the monitor, and the detached keyboard.

Unfortunately, a drawback of the system is the low quality keyboard. Often during program entry we had to strike the desired key more than once for it to register and get sent to the CPU. Furthermore, character images on the grey phosphor screen are not sharp. The 820's keyboard and screen are not well designed for a system being marketed as an Information Processor, where a real typewriter quality keyboard and easy to read screen become more important.

XEROX 820: HARDWARE COMPONENTS

STORAGE

- Dual 5¼-inch single-sided/single-density disk drives
- Dual 8-inch single-sided/single-density disk drives

OUR OBSERVATIONS

The Xerox 820 comes with either the 5¼ or 8-inch drives. The 5¼-inch drives each hold 81 kilobytes of information, while the 8-inch drives each hold 241 kilobytes of information. Xerox indicates that, in terms of word processing, this translates to approximately 40 pages and 130 pages of information, respectively.

Considering the availability of disk drives with much higher storage capacities, and even small hard disks at relatively low costs, we consider the storage capacity of the Xerox 820 to be one of its limitations.

OTHER DEVICES

Printers:

The system printer is a Diablo 630, 40 character-per-second, daisy wheel, bidirectional, and letter quality printer.

Output Ports:

The system comes with two built-in serial ports, and two built-in parallel ports. These can be used for printers, communications, and as I/O interfaces with external equipment.

OUR OBSERVATIONS

From our user survey's on other systems in this series we have noted an increasing number of small computers being purchased primarily for text processing applications. In keeping with this, a larger percentage of the printers being used are the slower, letter quality types. While these printers are more expensive than those designed for general use, a trade-off must be made between speed of throughput and the quality of the copy. The Diablo is a little slower than others, but it gets the job done.

XEROX 820: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, AND UTILITIES

Operating System:	CP/M
Languages:	BASIC-80 CBASIC COBOL-80
Access Methods:	In BASIC-80, sequential and random access
Utilities:	System Monitor CP/M utilities such as file management, text editing, disk copy, etc.

OUR OBSERVATIONS

CP/M by Digital Research is one of the mostly widely used operating systems for small computers. As a result, a wide variety of application programs has been developed and written for CP/M systems. Both compiled and interpretive BASIC's are available on the Xerox 820. Anyone using the 820 primarily for program development may prefer interpretive BASIC-80, while the application programmer may want to write programs to be run frequently in compiled CBASIC.

CP/M comes with a full set of utilities that the user would need to manage the system. The built-in monitor gives the user direct access to memory for examination and to make changes.

XEROX 820: SOFTWARE COMPONENTS

XEROX SUPPLIED PACKAGES

Xerox classifies software into three categories.

- Supported, documented, and maintained by Xerox
- Maintained by Xerox
- Outside software

The main piece of software which is fully supported by Xerox is the Word Processing System. Additionally, they supply CP/M, a teletype emulation package, and an IBM 3270 emulation package (binary synchronous communications).

They also supply the languages, and a few application packages.

Additionally, there is a good deal of software available from other sources which will run on the CP/M operating system.

OUR OBSERVATIONS

We have often remarked that there is a large base of software available for CP/M based systems. Perhaps we should qualify that statement with three cautions.

- While there is a large base of software, much of it is poorly written, has inadequate documentation, and little support. You should not purchase a package simply because the description looks good. You should find and interview users of the package, and determine the strong and weak points of the package. Even though the package costs are low ($200 to $500 typically), the true cost of an inadequate package could be very high if you consider the start-up costs of data entry and learning, and the potential cost of lost files and inaccurate information.

- Even the good packages may be designed for the least common denominator, such as line-by-line input rather than full-screen form fillout. Thus, while you may have spent a lot of money for a good terminal with full-screen capabilities, little software will be designed to take advantage of this or other unique features of your system.

- CP/M is an operating system, while computer programs are written in a programming language like BASIC, FORTRAN, and COBOL. Even with BASIC, there are several versions in common use. You should make sure you have the appropriate software to run the package you are purchasing. If not, you may buy the package and suddenly find you must spend another $500 or so on a language, linker, library routines, etc.

EDITOR

Under BASIC-80, the editor is line-oriented with no global change capabilities. Editing is accomplished by typing the command "EDIT" followed by a line number. A series of subcommands are then used to move the cursor on the line, display the line, and insert, delete, find, and replace text.

OUR OBSERVATIONS

As you run a BASIC program, the occurrence of a syntax error causes the system to go into edit mode with the line number of the faulty line displayed. You then can display and edit the line as necessary using the editing subcommands.

DOCUMENTATION

The documentation we used consisted of the CP/M manuals, the system information manuals, and the BASIC-80 manual. The CP/M manual is oriented toward the system programmer, while the BASIC-80 manual is oriented toward the application programmer. The BASIC manual is well indexed and contains illustrations of how various commands and statements are used. Though it is a single board microcomputer, the information on the system would be useful for anyone wanting to do assembly language programming or attempting to interface with external equipment.

MAINTENANCE AND TRAINING

Maintenance and training would be supplied by the dealer where you purchase the equipment. A standard 90-day warranty is included with the system.

CONCLUSIONS

Xerox, a well-known name in business machines, enters the microcomputer market with the Xerox 820. A single-user, non-expandable system, the 820 is built around popular and proven hardware and software components. Though frequently sold for text processing applications, the Xerox 820 can adequately meet some other small business computer needs as well.

The 820 is a single-board system employing the Z-80A microprocessor with 64K of central memory, all housed in the CRT unit. Though the system includes a detached keyboard (a feature we've always enjoyed), we felt the keyboard was of low quality. In addition, the grey phosphor screen produced character images that were not sharp. These problems, we believe, could make data-entry on the 820 an unpleasant chore.

The Xerox 820 performed adequately on all of our benchmark programs. Its timings would place it in the middle of the 24 systems we've tested to date.

Disk storage capability on the 820 consists of dual 8-inch floppy disk drives with a total capacity of 482 kilobytes. Xerox translates this figure into a storage capacity of approximately 130 pages of text. Additional storage cannot be purchased for the 820 which we feel can be a limitation to many users whose system must grow with their business.

Xerox supplies for the 820 the CP/M operating system, several languages, and the Word Processing System (based on WordStar). Communications packages are also available from Xerox giving the 820 remote intelligent workstation capabilities. As is true of other CP/M-based systems we've examined, a large body of independently developed software is also available to be run on the 820.

Unfortunately, Xerox did not supply us with user names for the 820. Consequently, we could not offer our usual user comments and summary.

The Xerox 820 represents another large system vendor's entry into the microcomputer market. With Xerox's experience and reputation, the 820 should quickly become established as a rough competitor in the small business computer market.

NOTES

NOTES

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

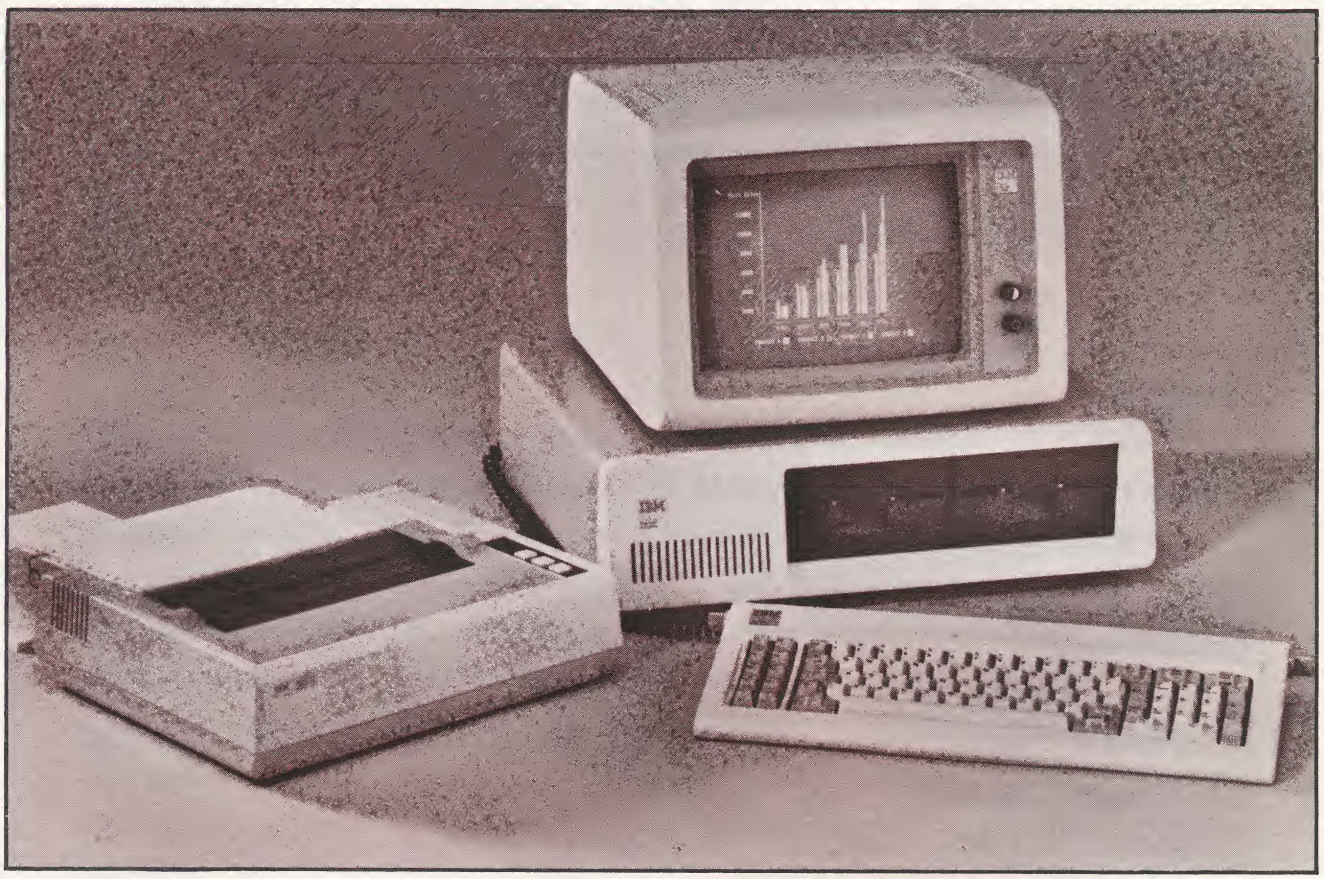
ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 13, DECEMBER 1981



In This Issue:

The IBM Personal Computer

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

IBM PERSONAL COMPUTER: BENCHMARK REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
Summary of Benchmark Results	5
Benchmarks:	
The Process: IBM/PC	6
Overview of Programs and Results	7
Detail Pages	
Pricing Components	13
Hardware Components	14
Software Components	17
Support Services	20
Summary of User Comments	21
Conclusions	23

PREFACE

The eleventh system in our continuation of Series 1 and 2 covers the IBM Personal Computer. Systems covered in this series are designed primarily for single users and cost less than $25,000. The IBM Personal Computer is the newest system to be offered in the personal computer market, and is the smallest system produced by IBM. It has been widely written and talked about, and we are pleased to present this report on what has been described as a "trend setting" small system.

The advantages and disadvantages of any system will depend upon the user's unique requirements. While many systems offer high level capabilities and user-friendly features originally designed for larger systems, they can be limited in expansion capabilities. Thus, a user of a small system may become frustrated upon finding that the system will not grow with the business. Some systems require more computer expertise to operate than others, some have features which would never be used in a business setting, some have limited software available, and some simply don't have the processing capability needed.

Indeed, because of all the potential "pitfalls" in purchasing a computer system, it is to everyone's benefit to learn as much about computers as possible, even in light of the trend toward user-oriented and turnkey systems. From our user surveys, we've found that overall, the most satisfied end-users are those who are most knowledgeable about computers. They know the limitations of a small computer system and consequently have the most realistic expectations of what a computer will do for their business.

Our benchmark reports continue to be a valuable resource for sifting through the often subtle differences among small computer systems. These reports provide the comparative results of running five benchmark programs on each of the systems under study, programs which represent capabilities needed by users in an operating environment. Additional information is given on the alternative configuration which can be assembled, internal and external storage and memory capabilities, languages available, the operating system, availability of application packages, and general comments on ease of use. Finally, a survey of users is conducted, and their comments on ease of use, relationships with hardware and software suppliers, problems encountered, etc., are included in each report.

EXECUTIVE SUMMARY

The IBM Personal Computer, priced at $4,550, as tested, consists of the main processor, 64 kilobytes of user memory, 40 kilobytes of read-only memory, dual 5¼-inch disk drives, keyboard, IBM Monochrome display, and the IBM printer. Expansion possibilities include an additional 196K of user memory, two additional disk drives, and a Color/Graphics output.

- The IBM disk operating system is based on the CP/M operating system, an extended version of Microsoft's BASIC-80, and the Intel 8088 microprocessor, with a 16-bit internal architecture and an 8-bit data bus. The benefit of the 16-bits is that mathematical calculations will be faster, while the 8-bit data bus simplifies peripheral interfacing.

- Documentation is excellent. Each DOS and BASIC command or statement was described, along with examples of use. The hardware manual was very well organized and complete, and included descriptions of organization, interfacing, schematics, etc. BASIC includes specific statements for handling the light pen and joystick inputs, as well as graphics and color control.

- The greatest limitation of the system is the 160K byte disks. Even though four disk drives can be attached, users with large data storage and retrieval requirements may find the system slow and inconvenient to use.

- Business users may prefer the IBM Monochrome high resolution display (which includes a parallel printer port), while others may prefer the Color/Graphics option with lower resolution but with graphics and color capabilities. The separate keyboard (on a 6-foot coiled cable) gives the user some flexibility in workstation layout. The keyboard includes a ten-key numeric keypad, cursor control, and function keys.

- Because it is a new system and we did not receive user names from IBM, we were not able to interview as many users as normal. However, the few local users we talked with were pleased with the system and were using it for home/professional applications.

- Its performance is comparable to a number of systems we have tested in this series. We found that its 16-bit microprocessor does not have a significant impact on the execution speed of most applications. The 1 megabyte of memory addressing (with 256K currently supported by IBM) is misleading since BASIC only supports 64K. The additional memory is probably well beyond the needs of most users, though PASCAL and FORTRAN may support a larger memory space.

Overall, the IBM Personal Computer appears to provide a capable small system for professional/business applications. If we were buying a computer today, the IBM Personal Computer would certainly be on our list of possibilities.

BENCHMARK REPORT

SYSTEM: IBM PERSONAL COMPUTER

PRICE AS TESTED: $4,550

SPEED TESTS

Benchmark Number		TOTAL TIME Min.	Sec.
	CPU INTENSIVE		
A-1	N = 500		17.5
A-2	N = 1000		34.3
A-3	N = 2000	1	7.8
A-4	N = 3000	1	41.5
A-5	N = 500		10.6
A-6	N = 1000		20.3
A-7	N = 2000		40.1
A-8	N = 3000		59.8
	I/O INTENSIVE		
B-1	N = 500		52.7
B-2	N = 1000		59.4
B-3	N = 2000	1	13.4
B-4	N = 3000	1	27.7

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	17	29.6
C-1A		6	18.1
C-2	NEW PRODUCT PLANNING		15.6
C-2A		1	36.1
C-3	ACCOUNTS RECEIVABLE	9	21.8
C-3A		12	4.4

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	201
E-2	SUBJECTIVE JUDGMENT	Easy

THE BENCHMARK PROCESS

All benchmarks were run on the IBM Personal Computer using their BASIC language (built into read-only memory and written by Microsoft). The system we tested contained 64 kilobytes of user memory (additional memory was attached, but BASIC only utilizes 64K), 40 kilobytes of read-only memory containing BASIC and input/output routines, dual floppy disks holding 160 kilobytes each, the IBM Monochrome Display, and the IBM printer.

From a programmer's view, the IBM Personal Computer (IBM/PC) looks much like any CP/M based system (CP/M is the widely used microcomputer operating system which has been the basis of many of the systems we have tested in this series). The operating system was written by Digital Research (the developers of CP/M) and the BASIC was written by Microsoft (the developers of the most popular of the CP/M languages).

While the system can be used with tape cassettes, we used a disk-based version. When the disk is inserted and the system started, you are at the operating system level with the standard file management utilities available for copying, formatting disks, etc. In addition, there is an editor available for creating files (such as data files, assembly language, etc.), and a debugger for working with assembly language programs.

A simple command puts the system into BASIC, where programs can be written, saved, and executed. At first glance, the BASIC seems to be a traditional textbook version, and most BASIC programs could easily be converted to run on the IBM/PC. However, there are some unique features offered: one particularly useful in business programming is the ability to check for a function key, and branching to different program segments on the basis of which key is pressed. Another is the ability to save and retrieve the contents of a screen, simplifying the programming of form fillout applications (particularly since several screens can be retained in memory and alternately displayed).

Since the IBM/PC was designed with the added capabilities of color graphics and games in mind, there are several BASIC statements which simplify the development of applications. Colors can be chosen (up to 16 in some instances), circles and lines drawn and moved on the screen, checking for light pen input, using a

joystick, and creating sounds on the speaker. These are controlled with commands such as PEN, SOUND, DRAW, LINE, CIRCLE, PLAY, STICK, etc. The language, in total, consists of about 150 different commands, functions, and statements.

We were very comfortable with the system. With the standard BASIC syntax, a beginner could write programs, and with the advanced features, some very interesting possibilities emerge. The keyboard is among the best we have seen, and is identical to the IBM System/23 small business system. Documentation is very professionally done, well organized, and includes extensive indexing and examples.

To run the benchmark timings, programs were transferred from another computer using the communications port and a small utility program written by the owner of the system we were using. Since the benchmark programs were written in Microsoft BASIC, they ran without any changes. Each program was loaded into memory and the RUN command typed in. Timings started when the enter key was pressed and stopped when output was complete.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

"Real Life" Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease Of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with "N" values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500		17.5 seconds
A - 2		N = 1000		34.3 seconds
A - 3		N = 2000	1 minute	7.8 seconds
A - 4		N = 3000	1 minute	41.5 seconds

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500	10.6 seconds
A - 6		N = 1000	20.3 seconds
A - 7		N = 2000	40.1 seconds
A - 8		N = 3000	59.8 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on floppy disks and retrives the first 50 of them in a factorial fashion (for example, a total of 1276 reads following 3000 writes). Several combinations were run with "N" values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500		52.7 seconds
B - 2		N = 1000		59.4 seconds
B - 3		N = 2000	1 minute	13.4 seconds
B - 4		N = 3000	1 minute	27.7 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of "N" equations with "N" unknowns:

$$0.1x_1 + 0.1x_2 + 0.1x_3 + \ldots + 0.1x_N = 0.2$$
$$0.1x_1 + 0.3x_2 + 0.3x_3 + \ldots + 0.3x_N = 0.4$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 0.5x_N = 0.6$$
$$\vdots \qquad \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots$$
$$0.1x_1 + 0.3x_2 + 0.5x_3 + \ldots + 9.9x_N = 10.0$$

To show that the run has been executed successfully, the values of x_1, x_2, and x_N are printed at the end of the execution.

C - 1	Results:	17 minutes 29.6 seconds

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results:	6 minutes 18.1 seconds

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A baseline run is established and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- Units Sold
- Selling Price
- Revenue
- Raw Material
- Distribution
- Gross Profits
- Fixed Costs
- Net Before Taxes

- Direct Labor
- Packaging
- Taxes Payable
- Net Income

C - 2	Results:	15.6 seconds

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	1 minute 36.1 seconds

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3	Results:	9 minutes 21.8 seconds

Variation: C-3 Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A

Results: 12 minutes 4.4 seconds

EASE OF USE TEST

The Ease of Use Test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 201 keystrokes were required to edit the nine-line test file.

Comment: IBM's full-screen editing facilities are very easy to use.

IBM PERSONAL COMPUTER: PRICING COMPONENTS

COSTS

IBM Personal Computer (as tested) $4,550

IBM/PC includes:

- Unit with processor, 64K of user memory, 40K read-only memory
- Dual 5¼-inch disk drives (160K of storage on each)
- Keyboard with 6-foot coiled cable
- IBM Monochrome Display and adapter board
- IBM Printer (a modified Epson MX-80)

Components

- Processor, 16K user memory, 40K read-only memory $1,320
- Additional 48K of user memory ..... $ 285
- Monochrome Display adapter (with printer port) ..... $ 345
- IBM Monochrome Display ..... $ 345
- Dual 5¼-inch disk drives $1,390
- Disk operating system ..... $ 40
- IBM Printer ..... $ 825

OUR OBSERVATIONS

The IBM Personal Computer is marketed through ComputerLand stores, Sears, Roebuck and Company, and IBM Product Centers. In addition to the configuration we tested there is a Color/Graphics option which may be purchased (instead of, or in addition to, the Monochrome Display and adapter). This can be connected directly to a color monitor or, through an RF modulator, to your color television.

The IBM/PC is based on the Intel 8088 microprocessor with an 8-bit data bus but a 16-bit internal structure. Since Intel has maintained upward compatibility within the 8000 line, a simple conversion program is all that is needed to upgrade 8080 or 8085 assembly code to run on the 8088. The 8088 addresses up to 1 megabyte of memory. The greatest benefit of the 16-bit architecture will be found in programs with a large number of multiply and divide instructions. Additionally, the Intel 8087 coprocessor (that is, it works in conjunction with the 8088 microprocessor) with greatly increased mathematical capabilities may become available for the IBM/PC at some later date.

(See Page 21 for user comments.)

IBM PERSONAL COMPUTER: HARDWARE COMPONENTS

CENTRAL UNIT .... A single unit contains the central processor, memory, dual disk drives, and additional 5 card slots for peripherals and memory expansion.

CPU Memory: The system contains 16K of user memory and 40K of read-only memory on the motherboard. An additional 48K of memory can be added without using up a card slot. IBM provides memory of 64K boards, so an additional 192K can be added (two of the card slots are taken by the disk controller and I/O driver). The system is capable of addressing 1 megabyte of memory, though IBM currently supports a maximum of 256K.

Keyboard: The keyboard is separate from the main unit and comes with a 6-foot coiled cord. The keyboard is identical to that on the IBM System/23 and contains a standard keyboard layout, 10 function keys, a numeric keypad, and cursor movement keys.

CRT Screen: We used the IBM Monochrome Monitor which provided very high quality resolution with white letters on a green background. The screen contains 25 lines of 80 characters per line.

OUR OBSERVATIONS

We have always liked detached keyboards since this gives some flexibility in workstation layout, and the operator is not constrained to one operating position.

The memory capacity of 256 bytes (with IBM supplied memory) and an addressing maximum of 1 megabyte provides an unbelievable capacity. However, BASIC operates with a 65K byte maximum, so the remaining memory must be used for assembly language programs.

Attributes can be set on the CRT characters which enable intensity, blinking, underline, and reverse video features. We found the screen to be very easy on the eyes.

The Color/Graphics option provides less resolution on characters. However, the graphics and color capabilities (with a medium resolution and high resolution graphics capability) may compensate for this loss. Some limited graphics capability (such as drawing bar graphs) is available on the Monochrome monitor since the character set on the IBM/PC includes graphics-like characters.

IBM PERSONAL COMPUTER: HARDWARE COMPONENTS

STORAGE

Storage on the IBM/PC includes tape cassette, and single or dual 5¼-inch floppy disk drives. Each diskette holds 160 kilobytes of data or program.

OUR OBSERVATIONS

With the disk system you must also add the disk controller card to the main computer chassis. The disk operating system includes disk commands as well as some enhancements to BASIC. In addition, there is an advanced BASIC which is available under the disk system.

An additional two disk drives can be added to the system, giving a total storage capacity, on-line, of 640K bytes.

OTHER DEVICES

Printers: IBM Parallel Printer

80 character-per-second
impact dot matrix
96 character print set

Communications: Serial asynchronous communications adapter

110 to 9600 baud rates
20 ma current loop and RS232C

Other: Joystick input (supported by Game Control Adapter)
Light pen input (supported by Color/Graphics Adapter)

OUR OBSERVATIONS

The printer is a modified Epson MX-80, a very popular and inexpensive unit. The system uses a standard Centronics-like interface, so other printers may be used with the system.

The game control adapter is supported with special BASIC statements. Although we associate joysticks with games, it is also possible to use joysticks for input to business applications.

IBM PERSONAL COMPUTER: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES, UTILITIES

Operating System:	IBM DOS
Languages:	BASIC (cassette, disk, advanced) Pascal Compiler FORTRAN Compiler
Access Methods (in BASIC):	Sequential Random (relative)
Utilities:	Standard file manipulation and management, editor, debugger

OUR OBSERVATIONS

The operating system was written by Digital Research, and appears very much like the CP/M operating system. This is also evident in the line editor and the debugger (the CP/M utilities ED and DDT for editor and dynamic debug and trace).

It has been announced that Digital Research is developing CP/M-86, the CP/M system for the 8086 microprocessor (and the 8088 used in the IBM Personal Computer). Though there may be some conversion necessary, this will open up a wide range of software already developed for the CP/M operating system.

IBM has announced a UCSD Pascal (P-code) for the Personal Computer.

The BASIC is contained in 32K bytes of read-only memory. The system provides a number of programmable function keys. Additionally, there are predefined function keys which display complete BASIC statements with a single keystroke (such as ALT-P simultaneously pressed produce the PRINT statement, reducing the number of keystrokes required to type a program).

IBM SUPPLIED PACKAGES

IBM Supplies software in three different series.

Business Series
- Easy Writer (word processing)
- VisiCalc (financial planning spreadsheet)
- General Ledger
- Accounts Payable
- Accounts Receivable

Education Series
- Typing Tutor
- Fact Track
- Authentic Game Set

Entertainment Series
- Adventure

OUR OBSERVATIONS

The accounting packages are based on the Peachtree series. These programs, while developed by outside sources, have been tested by IBM and are distributed as IBM products. The same is true of all software in the three series.

EDITOR

The editor from within BASIC is both line and screen oriented. You enter the edit mode, and can either list and edit a single line, or you can list the entire program and edit the entire screen.

OUR OBSERVATIONS

The screen approach in BASIC is very nice. The cursor can be moved to any location on the screen and characters inserted or deleted. The only requirement is that all changes on a single line be terminated with a carriage return, which places the cursor at the beginning of the following line. The cursor is then moved, using the arrow keys, to the location of the next change.

DOCUMENTATION

Among the best we have seen. The documentation is very well organized and well indexed, so it is very easy to find a concept or command. The DOS commands and BASIC commands and statements are each listed on a separate page, with pages in alphabetical order. Each page gives the syntax of the statement, parameters, and examples of its useage. Pages are 5½" by 8½" in loose leaf form.

In addition to the DOS and BASIC manuals, we looked at the hardware manual, and a system introduction manual. The hardware manual is particularly well organized. Each feature is clearly labeled, schematics and timing signals given, and configuration requirements (like switch settings) clearly identified. Having read many technical manuals, searching for an obscure reference to a critical requirement, buried in the middle of some unrelated text, we found the IBM technical manual an unexpected pleasure to read.

MAINTENANCE AND TRAINING

Maintenance and training are provided by the dealer. A 90-day warranty is provided.

SUMMARY OF USER COMMENTS

Since the IBM Personal Computer has only been on the market a short time and because IBM did not provide us with the names of current users, we were unable to conduct a formal survey of end users. We did talk briefly to four local users who had owned the system from two weeks to two months. Their combined reasons for choosing the IBM were the IBM name, add-on capability, and the Intel 8088 microprocessor. They were, in general, pleased with their choice. Some of the drawbacks they said it had were based in part on the fact that it was such a newly developed system and that, in one case, the user had little previous experience with computers.

Some of the users we talked to called their applications "professional home use" and were using it or planning on using it, for program development, accounting, word processing, forecasting, modeling, data base management and as a remote terminal. These users were already programmers or expecting to program with the IBM. A professional programmer said he rated IBM's BASIC quite highly. Two expected to upgrade memory and use Pascal. One person said he wanted to use Pascal because it is more portable. Those with Easy Writer liked it; two drawbacks mentioned were that it probably wouldn't have the capacity needed and that the backup routine was not working at this time. IBM's documentation was rated very highly except by one person who felt it was not written for novice computer users. Another user said it was "excellent."

Users liked the keyboard and screen, with one saying they were among the best he'd seen in ten years of using computers. A severe limitation of the system for one user was that the disk capacity was far too small for program development. He was looking forward to IBM's design of a larger storage device. Otherwise, storage of either one or two disk drives fit the users' needs.

The IBM Personal Computer is a new product and was owned only for a short period of time by those we spoke to. Nonetheless, they liked its present capabilities and were depending on IBM to improve its capacity and flexibility. However, one person noted that IBM provided only five expansion slots and felt once games and interfaces were added, "there wouldn't be room for anything else." He still felt it was "the system for high quality home use." Other users said they "adored it," and, "it works like they said it would."

CONCLUSIONS

We enjoyed the opporunity to review the IBM Personal Computer (IBM/PC) and found it to have many features and capabilities that one would expect to find on an IBM product. It's outstanding characteristics include a high quality, detached keyboard with programmable function keys, a high resolution screen, excellent documentation, color graphics capabilities, enhanced Microsoft's BASIC, Digital Research's CP/M operating system, and the Peachtree group of accounting programs. Users can also play games, use light pens and joysticks, use the IBM as a remote terminal, and attach many brands of printers and monitors.

As the IBM/PC has only been on the market a short time, an informal survey of a few users was conducted. They were pleased with both its present capabilities and what they expected to be added by IBM in the future. One person felt, though, that the small disk capacity was a serious shortcoming of the system. For others, one or two disk drives were adequate.

IBM's BASIC gives the programmer a lot of flexibility and allows him to write some high level and powerful programs. Additionally, there are function keys which in either BASIC or under program control, execute BASIC commands or other programmed functions. IBM's choice of the popular CP/M operating system gives users a full set of disk and system manipulation procedures. The actual implementation of CP/M on the IBM is unique and CP/M compatible application software on the market may not run directly on the IBM/PC. Software offerings at this time include word processing, accounting, games and educational programs.

In a maximum configuration with two dual disk drives, only a little over one-half megabyte of on-line storage is possible, spread across four drives. Certainly this will be enough for home use but could be limiting for many business applications. At first glance, 256K of user memory seems like an exciting amount, but there are few cases where that amount would be truly necessary in the everyday world of home or small business computer.

We think the IBM Personal Computer is an excellent home/professional computer and a viable possibility for small business users. It comes with IBM's reputation for quality and an implied promise of future upgradability.

NOTES

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227

BENCHMARK REPORT

Association of Computer Users

VOLUME 3.3, NUMBER 14, DECEMBER 1981

12 Issue Summary

- *IBM 5120*
- *SD SYSTEMS SD-200*
- *WANG 2200SVP*
- *ALTOS ACS8000-15 & ACS8000-6*
- *NEC ASTRA 205*
- *DYNABYTE 5300*
- *BILLINGS BC-12 DF2M*
- *COMMODORE CBM 8032*
- *SMOKE SIGNAL CHIEFTAN*
- *VECTOR GRAPHIC 3005*
- *XEROX 820*
- *IBM PERSONAL COMPUTER*

BENCHMARK REPORT is published and distributed by ACU Research & Education Division, Inc., a subsidiary of The Association of Computer Users, a not-for-profit user association and authored by the Business Research Division of the University of Colorado. Distribution of BENCHMARK REPORT is solely for the information and independent evaluation of subscribers, and does not in any way constitute verification of the data contained, concurrence with any of the conclusions herein, or endorsement of the products mentioned by the publisher. ©Copyright 1981, ACU Research & Education Division, Inc. No part of this report may be reproduced without prior written permission from the publisher. First class postage paid at Boulder, Colorado 80301.

12 ISSUE SUMMARY REPORT

TABLE OF CONTENTS

	Page
Preface	3
Executive Summary	4
The Benchmark Process	6
Benchmark Summary	8
Profiles:	
IBM 5120	10
SD Systems SD-200	11
NEC Astra 205	12
Altos ACS8000-15	13
Wang 2200SVP	14
Dynabyte 5300	15
Billings BC12 DF2M	16
Commodore CBM 8032	17
Smoke Signal Chieftain	18
Vector Graphic 3005	19
IBM Personal Computer	20
Xerox 820	21
Conclusions	22

PREFACE

This is the final issue in the series of reports, the Continuation of Series 1 and 2, in which we evaluated systems designed primarily for single users and costing under $25,000. This 12 Issue Summary is a valuable resource for anyone contemplating buying a computer. We provide side-by-side results of twelve computers' benchmark timings, comparisons and rankings with each other, our observations on trends and changes over the past few years and suggestions for choosing a small computer.

We start this issue with an Executive Summary which briefly summarizes each system. Next, the Benchmark Process gives an overview of the benchmark programs, and is followed by the Benchmark Summary, a detailed comparison of the Benchmark runs which reveal variations in computer hardware and allow easy comparisons across systems.

The central focus of this report is the Profile pages, where each system is ranked with a Benchmark standing from the benchmark programs. We also comment on these rankings, as well as the best features and the drawbacks of each system. Some systems will also have updates from the manufacturer which might include price changes, enhancements or new configurations.

Last are the Conclusions in which we provide our observations on trends in marketing, hardware offerings and changes in application software and operating systems. We've also made a few suggestions to help you make your "final" decision on which computer to buy.

Obviously it is impossible to compress in this one summary all of the information contained in the individual reports. Those reports should be read thoroughly because they contain details which illustrate subtle differences among the systems. Additionally, the individual reports often contain our comments about the relative importance of various features, cautions on evaluating systems, suggestions on how to choose a system, definitions of common computer terms, and common features and facilities which you should expect on any system you purchase.

EXECUTIVE SUMMARY

In this summary, we offer a thumbnail sketch of each of the systems tested over the past year. This should serve only as a brief reminder of system characteristics, and we would suggest that the reader also refer to the profile pages in this Summary Report and to the original Benchmark Report on each system.

- IBM 5120

  Sold through a network of IBM sales organizations, it is a floppy based single-user system. IBM offers an enhanced BASIC language and a high quality keyboard with programmable function keys. It has excellent editing facilities and did well on the CPU-intensive problem with exponentiation and square root functions but was the slowest system on the Scientific/Engineering problem using the same functions. For disk I/O problems it was fair to poor.

- SD SYSTEMS SD-200

  Another of the many Z-80A/S-100, CP/M based computers we've tested, we found it to be a good performer. It supports multi-users (up to five) and up to 96 megabytes hard disk. Users reported good hardware reliability. Its rankings on the benchmark programs were in the middle of other systems on both the I/O and CPU-intensive programs. SD System supplies and supports various application programs.

- NEC ASTRA 205

  The Astra 205 is sold through authorized NEC dealers generally as a turnkey system. The 205 has an exceptionally nice screen and detached keyboard which has programmable function keys. NEC developes and markets well thought out software that takes advantage of the screen-oriented features of the system. It was the slowest system in this series on all problems except the Scientific/Engineering problem. It took first place on the Edit test.

- ALTOS ACS8000-15

  The ACS8000-15 is sold by dealers who users said provided good support. The hardware was rated dependable by most of the users. It has a large (208k) user memory, partitioned for multi-user upgrades and can support up to 63 megabytes hard disk and 13 megabytes of tape storage. Overall, it ranked fair to poor on the benchmarks but it was a little faster on the Scientific/Engineering problem.

- WANG 2200SVP

  The SVP represents the low end of Wang's 2200 series of computers and features a 2 or 4 megabyte hard disk with a 1 megabyte floppy disk. BASIC-2 is a powerful version of BASIC although it is a little awkward on file handling capabilities. Users were very pleased with its speed. It far out distanced other systems on all the benchmark programs except the Accounts Receivable problem.

- DYNABYTE 5300

  Dynabyte offers a variety of configurations which include the capability of up to eight simultaneous users and 29 megabytes of hard disk storage.

Dynabyte also supplies business application program modules and has developed an easy to use system generation program to be used when changing the system configuration. Its timings put it in the slower group overall but it came in third on the Scientific/Engineering problem.

- BILLINGS BC12 DF2M

The Billings Corporation designed a competitive system that features an enhanced operating system and Billings' easy to use business application packages that users were generally pleased with. Users also reported that they received excellent support from their local Billings dealer. Its performance was good to fair on all the problems, except for those with printer output where it did excellent.

- COMMODORE CBM 8032

Designed as a personal computer it is also being used for business applications. A memory-mapped screen allows full screen movement of the cursor. A standard 32K of user memory, upgradable to 96K, comes with the system. Users were very pleased with the high resolution screen and excellent dealer support. It did well on I/O-intensive problems, although programming I/O with Commodore's BASIC is very cumbersome. For CPU-intensive problems its performance was fair.

- SMOKE SIGNAL CHIEFTAIN

The Chieftain uses the 6809 microprocessor and a UNIX-like operating system; with this combination its performance on the benchmark programs was excellent. Users were pleased with the Chieftain's hardware reliability, BASIC-09, and the operating system. Smoke Signal does not provide application software and users said a lack of off-the-shelf software was a drawback of the system.

- VECTOR GRAPHIC 3005

The 3005 is a multi-purpose single-user system with an integrated 5 megabyte hard disk and a 630 kilobyte floppy disk. Users were very happy with Vector Graphic supplied software and utilities. It was above average on all but the Accounts Receivable problem, which uses disk I/O. It did very well though, on the other I/O-intensive problem.

- IBM PERSONAL COMPUTER

The IBM/PC comes with a detached, high quality typewriter keyboard with programmable function keys. The CP/M operating system and BASIC-80 langauge gives this home computer many capabilities found on standard microcomputers, although storage capacity is limited. It ranged all the way from excellent on the CPU-intensive program with exponentiation and square root functions to fair on the disk I/O based problems.

- XEROX 820

Called the Information Processor by Xerox, the 820 is a general purpose computer that Xerox markets with their optional Word Processing text processing package. It uses the popular Z-80A microprocessor and the CP/M operating system. The 820 did well on disk I/O problems and fair on CPU-intensive problems.

THE BENCHMARK PROCESS

The set of benchmark programs described on the following page are the heart of this series of reports. It is important to review our procedures so the reader will understand how we conducted the benchmark tests and gathered the additional information contained in our reports.

As a baseline, each system tested was chosen to fit within the hardware specifications for this series: 64K of memory or less, dual diskette drives for storage, a CRT/keyboard unit for input and display, and a printer for hard copy output. Additionally, at the vendor's option, a hard disk could be included and tested as a supplement to the basic system.

For each system, the steps of the benchmark process were

- Evaluation of the system's BASIC for compatibility, or conversion to the alternate language
- Set up the system as delivered to us or at a local site provided by the vendor, or at a site provided by the Association of Computer Users
- Programs were entered and debugged by our staff
- Programs were executed and timed with a stopwatch by our staff
- Vendors could submit alternate results (either an optimized version of the program in BASIC, an alternate language, or hard disk)
- Vendor's results were verified by our staff

Additionally, for each of the systems we

- Reviewed all documentation included with the system
- Wrote an interview schedule covering computer usage in general, and specific characteristics of the system being benchmarked.
- Interviewed ten to fifteen users from a list provided by the vendor and the Association of Computer Users
- Re-checked information through local users and distributors, and by finding a system locally which we could use to run programs and tests

Using all of the information above, we then compiled and assembled a final report.

PROGRAM	DESCRIPTION
CPU-INTENSIVE A-1 A-4	Executes a variety of calculations including addition, multiplication, division, square root and exponentiation; runs through an iterative process N times, with "N" values of 500, 1000, 2000, and 3000.
A-5 A-8	Executes a variety of calculations including addition, multiplication, and division; runs through an iterative process N times, with "N" values of 500, 1000, 2000, and 3000.
I/O-INTENSIVE B-1 B-4	Stores numbers from 1 to N on disks and retrieves the first 50 of them in factorial fashion; run with "N" values of 500, 1000, 2000, and 3000.
SCIENTIFIC/ ENGINEERING C-1	Solves a system of linear equations (50 equations in 50 unknowns) using the Gauss-Jordan method of elimination.
C-1A	Performs the C-1 runs with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in C-1.
NEW PRODUCT PLANNING C-2	Calculates the relationship of production costs and profitability over a four-year period and produces a formatted report displaying results.
C-2A	Reports the timing for C-2 when results are routed to the printer for hard copy output.
ACCOUNTS REC. GENERATION C-3	Creates a file for 50 records, each with 10 fields; updates a file randomly 10 times by customer number for sales amounts and payments; prints reports with billing detail.
C-3A	Reports the timing for C-3 when results are routed to the printer for hard copy output.
EASE OF USE TEST	Changes a 9-line file using a variety of editing tasks. (Results are number of keystrokes.)

	IBM 5120	SD SYSTEMS SD-200	NEC ASTRA 205	ALTOS ACS8000-15	WANG 2200SVP	DYNABYTE 5300
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
CPU-INTENSIVE						
A-1 N = 500	21.4	39.6	---[1]	2:24.2	2.7	2:15.3
A-2 N = 1000	41.8	1:17.4	---	2:43.5	5.2	2:35.7
A-3 N = 2000	1:22.9	2:23.0	---	3:25.2	10.2	3:16.6
A-4 N = 3000	2:03.9	3:48.0	---	4:05.9	15.2	3:57.2
A-5 N = 500	24.9	11.0	5:18.7	2:06.0	2.4	1:54.6
A-6 N = 1000	48.9	20.4	5:53.3	2:08.4	4.5	1:57.3
A-7 N = 2000	1:37.3	39.1	7:02.5	2:13.1	8.8	2:02.0
A-8 N = 3000	2:25.5	57.8	8:11.8	2:17.8	13.0	2:06.6
I/O-INTENSIVE						
B-1 N = 500	2:23.6	1:07.8	6:59.8	2:33.9	7.6	2:40.9
B-2 N = 1000	2:43.3	1:15.0	7:12.5	2:39.2	10.6	2:48.5
B-3 N = 2000	3:20.9	1:30.9	7:24.8	2:49.3	16.9	2:57.0
B-4 N = 3000	3.58.0	1:49.3	7:45.9	3:01.7	23.0	3:07.2
REAL LIFE PROBLEMS						
C-1 Sci./Eng.	35:29.7	17:42.8	20:18.8	7:54.5	2:13.3	7:43.7
C-1A	12:43.0	6:25.9	10:53.9	4:18.9	48.4	4:08.0
C-2 New Prod.	25.0	10.5	8:32.3	2:30.6	5.2	2:22.2
C-2A	1:18.4	40.9	8:12.1	3:05.7	1:10.7	3:51.0
C-3 Acc./Rec.	4:16.2	6:16.4	26:26.4	10:41.5	2:23.0	11:01.5
C-3A	5:55.9	7:03.6	27:57.4	11:36.3	4:20.6	13:59.0
EASE OF USE (Keystrokes)	134	208	125	208	162	208

[1] NEC's BASIC language does not have square and square root functions.

NOTE: *For a full explanation of these benchmark results, refer to the individual issues on each of the systems.*

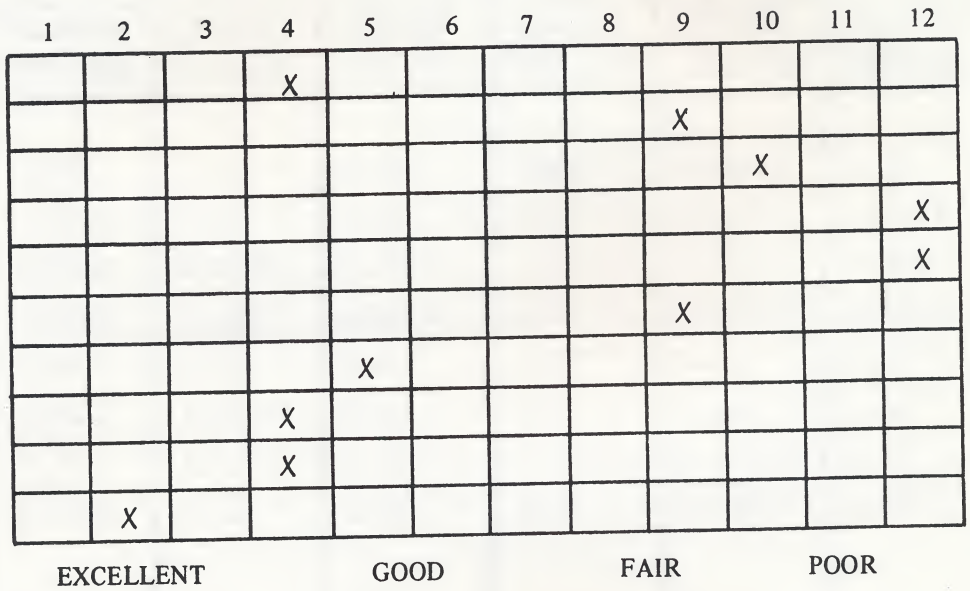
BILLINGS BC12 DF2M	COMMODORE CBM 8032	SMOKE SIGNAL CHIEFTAIN	VECTOR GRAPHIC 3005	IBM PERSONAL COMPUTER	XEROX 820	
RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	
						CPU-INTENSIVE
48.3	1:22.0	19.0	26.5	17.5	54.6	A-1 N = 500
1:34.5	2:42.2	34.6	51.5	34.3	1:46.8	A-2 N = 1000
3:06.9	5:22.6	1:06.2	1:41.8	1:07.8	3:31.3	A-3 N = 2000
4:39.2	8:02.8	1:37.4	2:32.1	1:41.5	5:17.3	A-4 N = 3000
13.3	19.0	5.4	7.4	10.6	15.4	A-5 N = 500
24.3	35.9	7.4	13.6	20.3	28.4	A-6 N = 1000
46.5	1:10.0	11.7	26.0	40.1	57.7	A-7 N = 2000
1:08.6	1:43.8	15.8	38.3	59.9	1:20.7	A-8 N = 3000
						I/O-INTENSIVE
1:45.0	57.8	1:26.9	35.0	52.7	59.0	B-1 N = 500
1:55.1	1:07.8	1:33.7	41.3	59.4	1:08.3	B-2 N = 1000
2:29.1	1:27.5	1:51.9	56.9	1:13.4	1:26.5	B-3 N = 2000
3:00.3	1.47.1	2:10.2	1:13.7	1:27.7	1:45.9	B-4 N = 3000
						REAL LIFE PROBLEMS
21:48.6	23:45.1	3:13.3	11:34.1	17:29.6	24:37.0	C-1 Sci./Eng.
7:52.9	8:35.7	1:09.5	4:12.2	6:18.1	8:56.6	C-1A
14.2	20.0	5.7	13.1	15.6	10.6	C-2 New Prod.
36.6	2:36.0	43.9	1:18.8	1:36.1	1:53.7	C-2A
5:09.2	3:36.0	1:40.7	7:45.6	9:21.8	5:30.1	C-3 Acc./Rec.
5:49.5	8:47.0	3:03.4	9:49.7	12:04.4	8:36.0	C-3A
208	250	177	208	201	208	EASE OF USE (Keystrokes)

NOTE: *For a full explanation of these benchmark results, refer to the individual issues on each of the systems.*

PROFILE: IBM 5120

Price as tested = $13,705

BENCHMARK STANDINGS



COMMENT: *The 5120 did above average on the CPU-intensive program with exponentiation and square root functions but was the slowest system on the Scientific/Engineering problem. It placed well on the editing test.*

BEST FEATURES.....IBM provides application software, complete and professional documentation, and maintains a large network of service representatives. The 5120 comes with AP/L or an enhanced BASIC. IBM's keyboard is of typically high quality and comes with programmable function keys.

DRAWBACKS.....The hardware is non-expandable except for two additional floppy disk drives; the terminal has only a 9-inch CRT. Generally, the software that is available has to be modified before it can run on the 5120. Although the documentation is complete, it overlaps onto two or three manuals, and finding complete information is time consuming.

UPDATE: *As of October 1, 1981, the price of the 5120 has been reduced 35 percent. However, the new IBM System/23 effectively replaces the 5120 at the bottom of IBM's product line. The System/23 is a single-user system expandable to 128K of main memory and 4.4 megabytes floppy disk storage.*

PROFILE: SD SYSTEMS SD-200

Price as tested = $12,300

BENCHMARK STANDINGS

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A2						X						
	A6					X							
I/O	B2						X						
SCI/ENG	C1							X					
	C1A							X					
NEW PROD	C2			X									
	C2A		X										
ACC REC	C3							X					
	C3A					X							
EDIT	E1						X*						

EXCELLENT GOOD FAIR POOR

COMMENT: *The SD-200 is a solid performer in all categories. The number 2 ranking for C2A reflects the speed of the 150 cps TI 810 printer.*

BEST FEATURES.....The Z-80A/S-100 bus combination plus the CP/M operating system and BASIC-80 is a popular configuration and allows versatility with the hardware as well as with CP/M compatible packages and languages. It is upgradable to five users and 96 megabytes of hard disk. SD Systems supplies some software packages.

DRAWBACKS.....The SD System manuals were poorly written and organized which tends to make the end-user more dependent upon the dealer. Its price was slightly higher than other comparable microcomputers we tested.

UPDATE: *The SD-200 is now being marketed with the OASIS operating system. SD Systems is also modifying the MP/M multi-user operating system to run on SD computers.*

*Six systems using BASIC-80's editing facilities tied for the sixth place on the Edit test.

PROFILE: NEC ASTRA 205

Price as tested = $11,950

BENCHMARK STANDINGS

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A2*												
	A6												X
I/O	B2												X
SCI/ENG	C1								X				
	C1A											X	
NEW PROD	C2												X
	C2A												X
ACC REC	C3												X
	C3A												X
EDIT	E1	X											

EXCELLENT GOOD FAIR POOR

Comment: *All of the 205's times are compile plus run times. Run times alone will be faster for established programs. NEC's screen-oriented editor outranked all others.*

BEST FEATURES..... The 205 features 27 function keys, a detached keyboard, a 16-bit processor and NEC supplied business packages. There are security (password) and multi-tasking capabilities. The application documentation is clear and helpful.

DRAWBACKS..... System documentation is not written for an end-user. The 205 is usually sold as a turnkey product since the operating system and COBOL-like BASIC are more complex and less well documentated than other single-user systems. Compile-link time consumes a disportionate amount of time during program development. It is non-expandable but the software is upward compatible with other Astra systems. The 205 comes with a higher price tag than many single-user, floppy based microcomputers.

UPDATE: *System price has dropped from $8,560 to $6,500. The total cost with a 120 cps printer is $9,890. The cost of adding a third 1.2 megabyte drive has gone down $1,000.*

*The Astra 205 did not have exponentiation or square root functions.

PROFILE: ALTOS ACS8000-15

Price as tested = $9,875

BENCHMARK STANDINGS

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A2											X	
	A6											X	
I/O	B2									X			
SCI/ENG	C1				X								
	C1A					X							
NEW PROD	C2											X	
	C2A										X		
ACC REC	C3										X		
	C3A									X			
EDIT	E1						X*						
		EXCELLENT				GOOD				FAIR			POOR

COMMENT: *We used Microsoft's compiled BASIC-80; run-only times were faster. It was a little above average on the Scientific/ Engineering problem.*

BEST FEATURES.....Starting with the floppy based -15 an owner may upgrade the hard disk storage in increments up to 29 megabytes that fit his needs. The -15 comes with 208K of central memory partitioned for multi-user operations. Many CP/M compatible languages and programs may be purchased for the Altos. Users reported good hardware reliability.

DRAWBACKS.....The ACS8000-15 is not an integrated system (a user must choose his own configuration and peripherals) and the documentation is primarily written as a reference and would not be suitable for anyone just learning programming or computer operations.

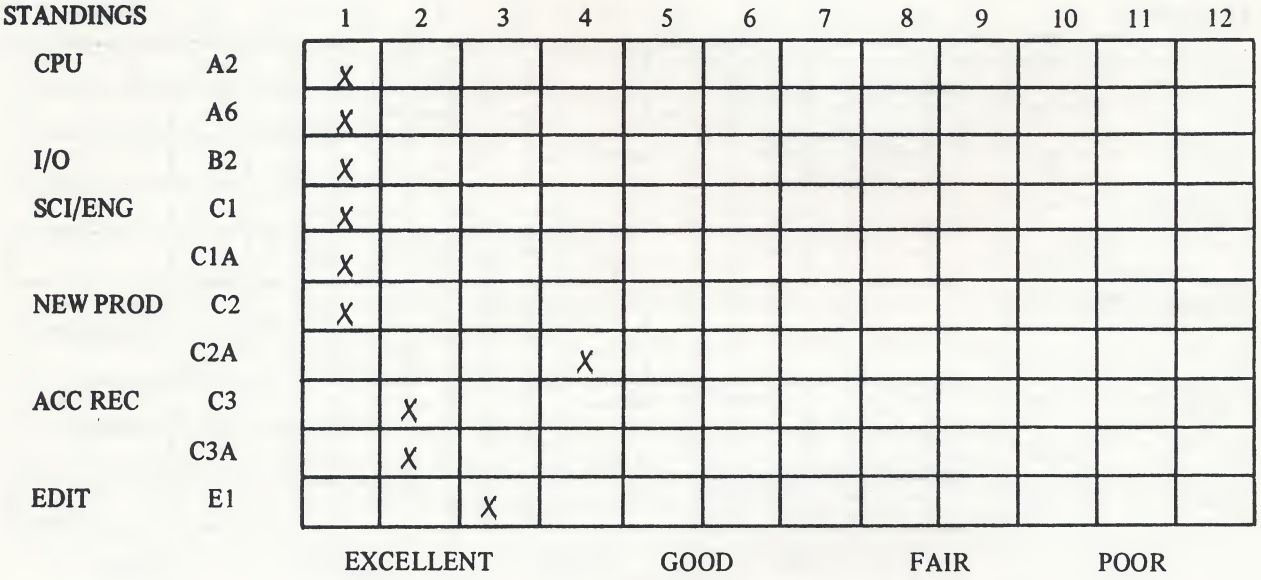
UPDATE: *Altos has dropped the system price on the -15 by $1,000, and has discontinued selling the 14-inch hard disk; an 8-inch is now the largest they sell.*

*Six systems using BASIC-80's editing facilities tied for sixth place on the Edit test.

PROFILE: WANG 2200SVP

Price as tested = $14,600

BENCHMARK STANDINGS



COMMENT: *The SVP's overall performance was excellent.*

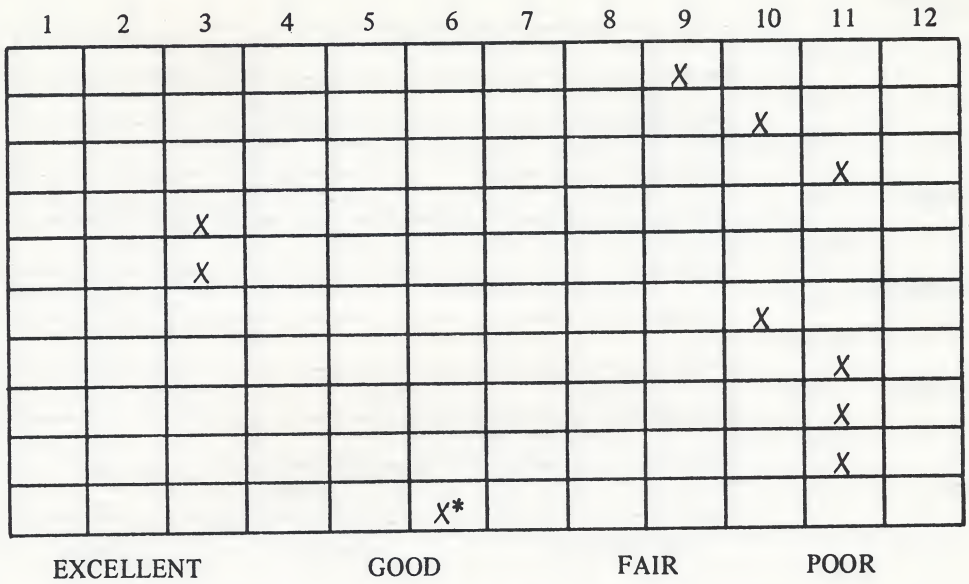
BEST FEATURES.....Wang offers several application programs, an enhanced, powerful version of BASIC, clear, concise documentation and a 2 or 4 megabyte integrated hard disk. Programs written for the SVP may be run on other 2200 series computers.

DRAWBACKS.....The SVP is one of the more expensive single-user systems and Wang does not provide upgrade options. File handling capabilities are very cumbersome under BASIC-2 and do not allow random accessing of files.

PROFILE: DYNABYTE 5300

Price as tested = $8,535

BENCHMARK STANDINGS



COMMENT: *The 5300 did very well on the Scientific/Engineering problem and with its compile plus run times it placed in the slower group on other problems.*

BEST FEATURES.....With the addition of the MP/M operating system, the 5300 can support up to eight users and can have up to 29 megabytes of hard disk storage. Up to four CRT's and four printers may be attached to the main computer at one time, though only one of each may be used at a time. Another system with the CP/M operating system, a user has a choice of languages and application programs. Dynabyte also has developed some of their own business packages. The 5300 also offers an enhanced system generation utility that greatly simplifies hardware reconfiguration.

DRAWBACKS.....Manuals sold with the 5300 and produced by Microsoft and Digital Research were not written for novice computer users. Application software was usually the cause of any dissatisfaction with the 5300.

UPDATE: *The processor and dual 8-inch drives each cost about $400 less now: total price is $800 lower.*

*Six systems using BASIC-80's editing facilities tied for the sixth place on the Edit test.

PROFILE: BILLINGS BC12 DF2M

Price as tested = $12,395

BENCHMARK STANDINGS

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A2							X					
	A6						X						
I/O	B2								X				
SCI/ENG	C1									X			
	C1A								X				
NEW PROD	C2						X						
	C2A	X											
ACC REC	C3					X							
	C3A			X									
EDIT	E1						X*						
		EXCELLENT				GOOD			FAIR			POOR	

COMMENT: *Using a P-510 180 cps printer, the Billings did best on programs that also tested output to the printer. Otherwise, its performance was good to fair.*

BEST FEATURES.....The Billings operating system is based on the single-user version of Phase One System's operating system, OASIS. This is a sophisticated and enhanced operating system that is usually found on minicomputers. Other software offerings include FORTRAN, COBOL, Macro Assembler, screen and printer forms generators and well designed, easy to use business application packages. Users said the hardware was dependable and that dealer support was very good. The 180 cps printer cost less than many 55 cps printers on the market.

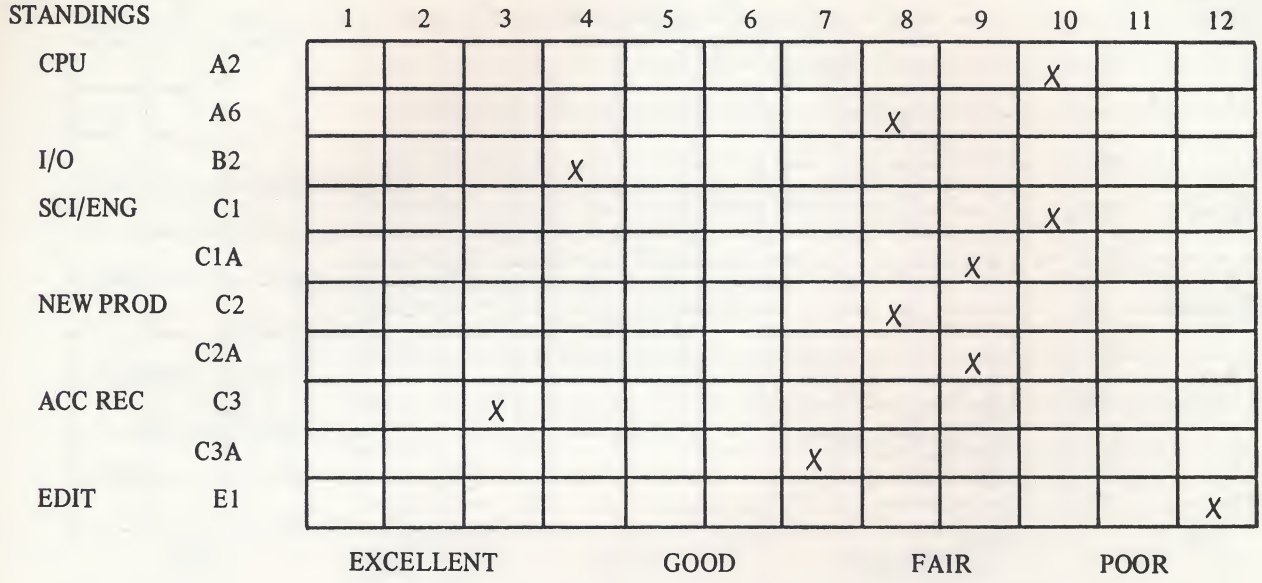
DRAWBACKS.....The BC12 DF2M is a single-user, non-upgradable system. Users said Billings documentation was too technical or incomplete.

*Six systems using BASIC-80's editing facilities tied for sixth place on the Edit test.

PROFILE: COMMODORE CBM 8032

Price as tested = $4,085

BENCHMARK STANDINGS



COMMENT: *The 8032's timings range from excellent to fair. Its disk I/O timings were better than for the CPU-intensive problems. The full-screen editor was easy to use but required more keystrokes on the edit test than any other system.*

BEST FEATURES.....For its price and designed primarily for home use, the 8032's performance on the benchmark programs was very acceptable. Users also were pleased with its efficiency to cost ratio. They rated hardware reliability and dealer support very highly. The editing facilities include complete freedom of cursor movement on the screen and the ability to repeat program statements. The system comes with 32K of central memory and is upgradable to 96K. The system also provides graphics capabilities.

DRAWBACKS.....Commodore's version of BASIC lacks enhancements like PRINT USING and is particularly cumbersome for programming disk I/O procedures. Manuals sold for use with the CBM 8032 are poorly organized and indexed. The system is non-expandable and provides only one megabyte of on-line storage. Although central memory is upgradable to 96K, many users felt their software would not be compatible with this upgrade.

PROFILE: SMOKE SIGNAL CHIEFTAIN

Price as tested = $8,149

BENCHMARK STANDINGS

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A2			X									
	A6		X										
I/O	B2							X					
SCI/ENG	C1		X										
	C1A		X										
NEW PROD	C2		X										
	C2A			X									
ACC REC	C3	X											
	C3A	X											
EDIT	E1				X								
		EXCELLENT				GOOD				FAIR			POOR

COMMENT: *The Chieftain's performance was excellent except for the disk I/O-intensive program. Its editing features gave it a good ranking.*

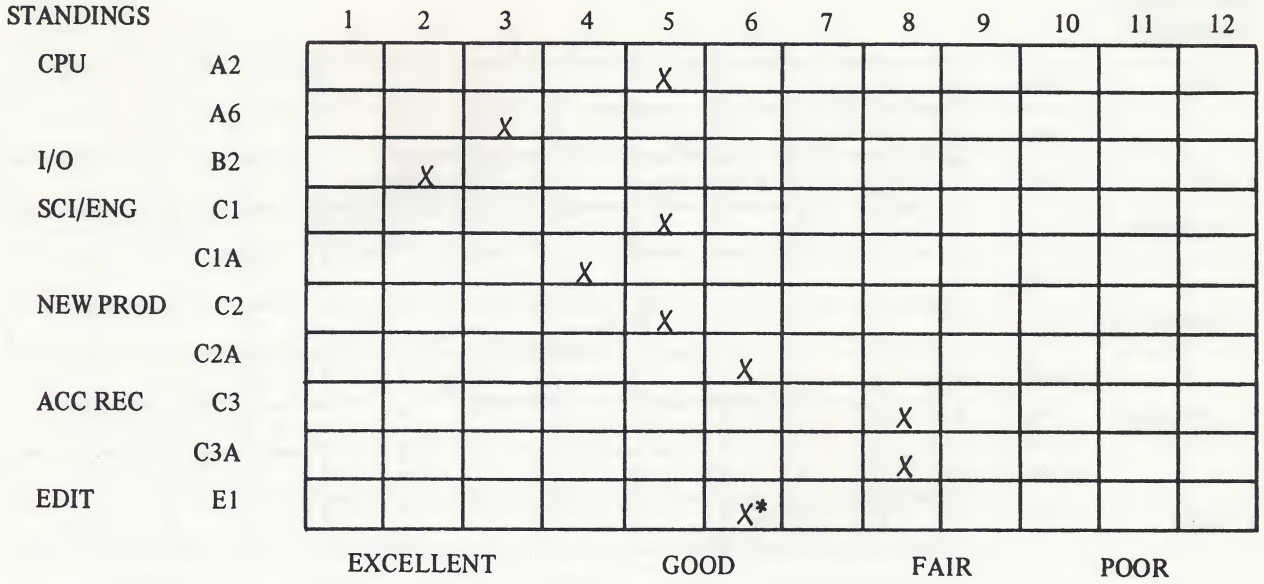
BEST FEATURES.....One of the major advantages of the Chieftain is its multi-tasking/multi-user capability. The operating system, OS-9, is similar to the UNIX operating system developed by Bell Laboratories, and takes advantage of the unique programming features of the 6809 microprocessor. BASIC-09 is an enhanced version of BASIC and includes a TYPE statement which allows the creation of user defined data structures. Users reported that the Chieftain hardware was reliable.

DRAWBACKS.....A shortcoming of the Chieftain was the documentation which, for most of the users, was too technical. Smoke Signal does not supply application software and the software that is available for the Smoke Signal was either not suitable for user applications or they were unaware that it was available.

PROFILE: VECTOR GRAPHIC 3005

Price as tested = $11,150

BENCHMARK STANDINGS



COMMENT: *The 3005 did well on all the benchmarks but was only fair on the Accounts Receivable problem, which tests disk I/O.*

BEST FEATURES.....Vector Graphic uses the popular CP/M operating system and Microsoft's BASIC-80. This combination gives the 3005 versatility, power and a good user/system interface. Hardware features include an integrated 5 megabyte hard disk, a 630K floppy disk drive and a memory-mapped screen. Vector Graphic has developed some application packages and utilities that end users were quite pleased with. Users said they had a good relationship with their dealers and the hardware was dependable once they overcame startup problems. System documentation is complete.

DRAWBACKS.....It is a single-user, 5.8 megabyte system that is not upgradable. Many of the users had little previous experience with computers and felt the documentation was too technical and unsuitable for beginning computer users.

UPDATE: *In January 1982, a 13.5 megabyte tape cartridge called Safstore will be available for the 3005. Price of the unit will be $3,695. Upgrades to the software include X-CP/M which will use two 64K RAM's--one for the system and one for the user. A spooling utility is also included.*

*Six systems using BASIC-80's editing facilities tied for the sixth place on the Edit test.

PROFILE: IBM PERSONAL COMPUTER

Price as tested = $4,550

BENCHMARK STANDINGS

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A2		X										
	A6				X								
I/O	B2			X									
SCI/ENG	C1						X						
	C1A						X						
NEW PROD	C2							X					
	C2A							X					
ACC REC	C3									X			
	C3A										X		
EDIT	E1					X							

EXCELLENT GOOD FAIR POOR

COMMENT: *The IBM/PC went from excellent on both the CPU- and I/O-intensive problems to fair when the two capabilities were combined in one program. It has good editing functions.*

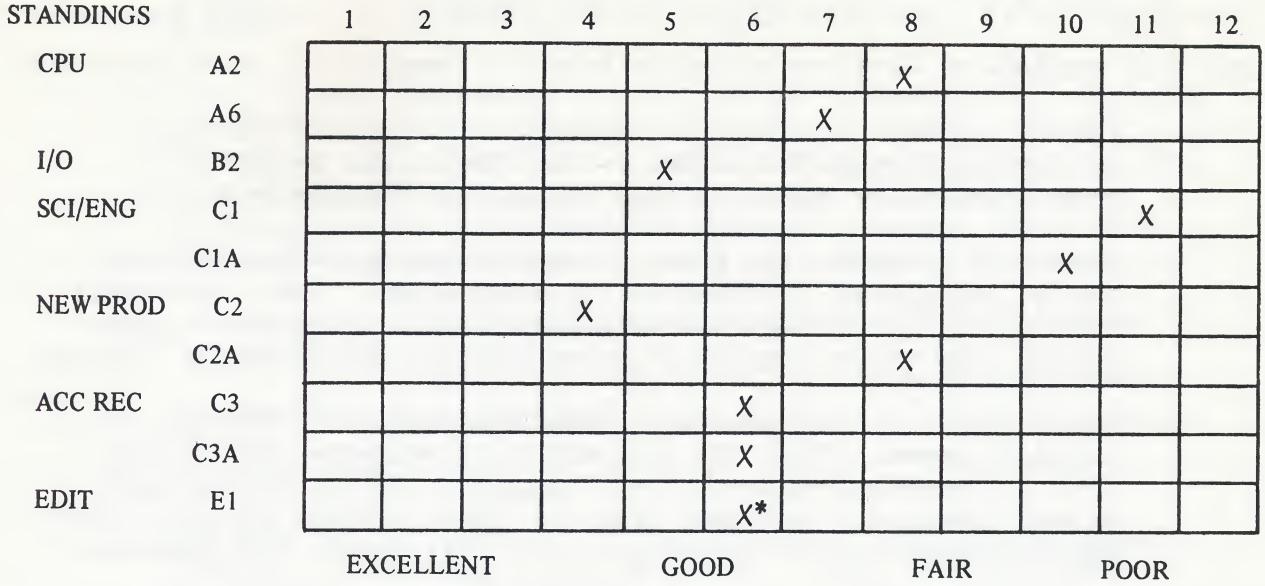
BEST FEATURES.....The IBM/PC uses a 16-bit processor, an extended version of Microsoft's BASIC-80, and IBM's own implementation of the CP/M operating system. IBM supplies some business packages, games and educational programs. Color graphics with light pens and joysticks are also available. It has full-screen editing capabilities. IBM has written excellent documentation and offers a high quality, detached keyboard with programmable function keys.

DRAWBACKS.....The major limitation of the IBM/PC is the small storage capacity--640K with 2 dual floppy disk drives. Since BASIC only supports 64K of memory, additional memory is probably beyond the needs of most users.

PROFILE: XEROX 820

Price as tested = $7,220

BENCHMARK STANDINGS



COMMENT: *The 820's performance on problems with exponentiation and square root functions was not as good as on the problems with disk I/O.*

BEST FEATURES.....The Xerox 820 is produced by an established, reputable company which has chosen the popular operating system, CP/M, and the enhanced business language, BASIC-80, for their system. It employs a single-board technology with a Z-80A processor and allows a full 64K of user memory. The documentation, while not produced by Xerox, is complete but written for end-users with previous computer experience. Xerox supplies a text processing package called "Word Processing."

DRAWBACKS.....Maximum on-line storage with dual 8-inch floppy disk drives is only 482 kilobytes and is non-expandable. For a system marketed as an Information Processor, the keyboard was not of good typewriter quality and the CRT did not provide clear, sharp images.

*Six systems using BASIC-80's editing facilities tied for the sixth place on the Edit test.

CONCLUSIONS

As we look back over trends in the thirty-six systems covered during the past four years, it is clear that changes in both hardware and software have had and will continue to have a significant impact on computer purchase decisions.

- There is a wider selection of equipment available as new small manufacturers enter the market, and as the larger established firms develop new systems at the low end of their product line.

- Because many systems are based on established microcomputer technology, performance differences are often minor. Thus, users will have to turn increasingly to expansion capability, software availability, and vendor support as prime criteria for selecting a system.

- Retail stores are becoming more prevalent as distributors of computing power. There are specialists in hardware, and off-the-shelf software stores are becoming popular. Stores selling time on small computers, allowing users to set-up systems and experiment before committing to hardware purchase, will become more widespread.

- Smaller systems are coming with built-in multi-user capability, simplifying the upgrade from single to multi-user systems as a business expands.

- Prices are declining while capabilities are increasing. The value received per dollar of expense is so much greater today than four years ago that computing power is within the reach of almost every small business.

- One of the major enhancements to small systems is larger storage capacity. Many systems today come with a single floppy and a hard disk, giving the benefits of both removable and fixed capabilities, with none of the disadvantages of either alone.

- While the 16-bit microprocessor has become a low cost reality, it will not obsolete the 8-bit systems. There is such a large base of equipment, operating systems, and application software for the 8-bit systems, combined with adequate performance in business and home applications, that they remain a viable alternative.

- Many of todays operating systems are enhanced with user-friendly features which simplify use of the system. This is particularly noticeable in some recent CP/M versions where vendors have provided utility programs to help in system configuration, screen-oriented editors, etc.

- Software is improving as professionals take over the writing of microcomputer applications. Manufacturers are writing software and/or customizing general packages, taking advantage of the unique features of their system and providing applications which are more reliable and easier to use than ever before.

- Many of today's systems come with word processing capabilities, adding value and versatility to small computers. While many small businesses could not justify either word processing or computing alone, a single system with both capabilities may be a good investment.

- A significant software trend will be the development of "program generators," or software to write software. You specify what your files look like, how they are related, what computations to make, what screens of information look like, etc., and the program generator writes the appropriate computer program. With these generators, programmer productivity will increase significantly.

For many of you these trends are interesting, but you're still asking the question "Given that I've narrowed the choice down to a few affordable alternatives, how do I make the final choice?" We have a few suggestions and questions you should ask.

- Evaluate the applicability of the software. Does it provide the majority of the reports you want and/or need? Will you have to make major changes in your operating procedures in order to implement the system?

- What is the capacity of the system, both memory size and storage? Is your application pushing the limits?

- What expansion capabilities are built into the system? Will it grow with your business or will you have to change systems in a couple of years?

- What kind of support is provided? Is documentation usable, does the supplier guarantee the software and hardware, is technical hot-line support available for the hardware and software, and is service readily available?

- Do you feel "comfortable" with the vendor's personnel? You will be working closely with them in implementing your system, and the relationship must be built on confidence and trust.

- Finally, <u>check references</u>. Ask them about the good and bad features of the system, and about support. Ask each user if they know of other users (remember, the vendor will probably provide you with the names of successes, not failures).

Of course, asking the right questions and getting the right answers does not guarantee the system will work for you, but it certainly increases the probability that you will number among the "successes."

BENCHMARK REPORT

Vol. 3.3, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members $150/year, non-members $190/year. Overseas subscribers add $30 for airmail postage.

An association to help the computer user make informed decisions. . .

The Association of Computer Users is a world-wide professional organization devoted to providing an unbiased source of user oriented information on computers for business and scientific applications. It is organized as a nonprofit association to represent and serve computer users, and to provide a forum for the exchange of information about the many systems in use today.

ASSOCIATION OF COMPUTER USERS
P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 443-3600

BUSINESS RESEARCH DIVISION
University of Colorado
Boulder, Colorado 80309
Tel. (303) 492-8227